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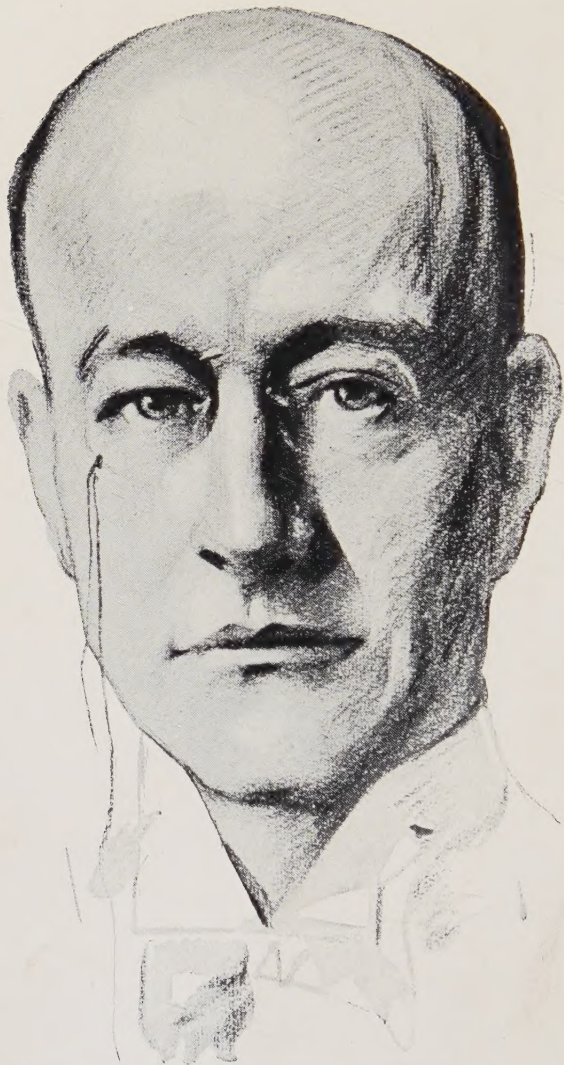
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S. J. Woolf :

Roy Chapman Andrews, Sc.D.
From the portrait study by S. J. Woolf.

ON THE TRAIL OF ANCIENT MAN

A NARRATIVE OF THE FIELD WORK OF THE
CENTRAL ASIATIC EXPEDITIONS

MB

BY

ROY CHAPMAN ANDREWS, Sc.D.

LEADER OF THE CENTRAL ASIATIC EXPEDITION OF THE AMERICAN MUSEUM OF
NATURAL HISTORY IN COÖPERATION WITH "ASIA MAGAZINE"

WITH AN INTRODUCTION AND A CHAPTER BY
HENRY FAIRFIELD OSBORN

PRESIDENT, AMERICAN MUSEUM OF NATURAL HISTORY

Illustrated With Photographs by J. B. Shackelford

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To My
COMRADES IN THE FIELD

WHOSE COURAGE, LOYALTY AND DEVOTION TO THE
IDEALS OF SCIENCE HAVE MADE POSSIBLE THE SUCCESS
OF THE CENTRAL ASIATIC EXPEDITIONS, THIS ACCOUNT
OF OUR EXPLORATIONS IS AFFECTIONATELY DEDICATED.

STAFF OF THE CENTRAL ASIATIC EXPEDITIONS
OF 1922, 1923, AND 1925

ROY CHAPMAN ANDREWS, Leader and Zoölogist.

WALTER GRANGER, Chief Palæontologist, 1922, '23, '25.

DR. CHARLES P. BERKEY, Chief Geologist and Petrographer,
1922 and 1925.

FREDERICK K. MORRIS, Assistant Geologist, 1922, '23, '25.

GEORGE OLSEN, Assistant in Palæontology, 1923 and '25.

PETER KAISON, Assistant in Palæontology, 1923.

ALBERT JOHNSON, Assistant in Palæontology, 1923.

RALPH W. CHANEY, Palæobotanist, 1925.

NELS C. NELSON, Archæologist, 1925.

CLIFFORD H. POPE, Assistant in Zoölogy, 1922, '23, and '25
(Chinese Division).

L. B. ROBERTS, Chief Topographer, 1925.

F. K. BUTLER, Assistant in Topography, 1925.

H. O. ROBINSON, Assistant in Topography, 1925.

J. B. SHACKELFORD, Photographer, 1922 and '25.

S. BAYARD COLGATE, Chief of Motor Transport, 1922.

J. MCKENZIE YOUNG, Chief of Motor Transport, 1923, '25.

C. VANCE JOHNSON, Motor Transport, 1923.

NORMAN LOVELL, Motor Transport, 1925.

F. A. LARSEN, Interpreter, 1922.

T. BADMAJAPOFF, Representative of the Mongolian Govern-
ment, 1922.

HAROLD LOUCKS, Surgeon, 1925.

FOREWORD

ASIA THE MOTHER OF CONTINENTS

IT was seldom that the Oracle of Delphi gave an immediate response to the solicitous inquiries of those seeking Divine counsel; repeated libations and other sacrifices were offered at the shrine; the final reply of the gods was diplomatic, so that the ambiguity of Delphic utterance has become proverbial. Not so with the American Museum quest in the arid Temple of Nature in Mongolia; almost at the very outset the invincible leader, Roy Chapman Andrews, aided by his highly trained American experts, met with the unequivocal response: *Asia is the mother of the continents!*

The initial discovery in the Gobi Desert of the presence of fossil quadrupeds, christened "Titanotheres" (or beasts of titanic size) when discovered in South Dakota, in 1852, gave an answer to one of the four great questions which the Expedition undertook to solve; namely, whether ancient Asia was the mother of the life of Europe to the far west and of North America to the far east. It was a realization similar to the discovery of a palæontologic Garden of Eden—of the birthplace or Asiatic homeland

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from which many kinds of reptiles and mammals spread westward and eastward. The existence of such a centre had long been a matter of pure theory on the part of palæontologists, and as early as 1900 the writer of this foreword summed up his faith in the existence of such an Asiatic homeland, publishing in the columns of *Science* (April 13, 1900, page 567) a prophecy which may be paraphrased as follows:

“We now turn to the northern hemisphere, to the Arctogæa or homeland area of animal dispersal in the dawn period of the mammalian life on the soil of the northern hemisphere. First, on opposite sides of the globe we observe two great colonies, one in Europe and one in the Rocky Mountain region of America, which are full of different degrees of kindred in their mammalian life; yet they are separated by ten thousand miles of intervening land in which not a single similar form is found.

“The fact that the same kinds of mammals and reptiles appear simultaneously in Europe and in the Rocky Mountain region has long been considered strong evidence for the hypothesis that “the dispersal centre is half-way between.” In this dispersal centre, during the close of the Age of Reptiles and the beginning of the Age of Mammals, there evolved the most remote ancestors of all the higher kinds of mammalian life which exist today, including, for example, the five-toed horses, which have not as yet been discovered in either Europe or America. That the very earliest horses known in either Europe or America are four-toed indicates that their ancestors may have lost their fifth toe

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while still resident in the Asiatic homeland. The history of northern Asia remains unknown until the period of the Ice Age, when man first appears; yet theoretically we are certain that it was part of a broad migration and dispersal belt which at one time linked together the colonies of France and Great Britain with those of the Rocky Mountain region of Wyoming and Colorado. Though the kinds of animals which we find in these two far-distant colonies are essentially similar and every year's discovery increases the resemblance and diminishes the difference between the life of Europe and the life of the Rocky Mountain region, connecting links are entirely unknown. It follows that northern Asia must be the unknown migration route between these two far-distant colonies."

All this, set forth in 1900 by the writer of this Foreword, was in the nature of a palæontologic oracle, but was written with such confidence in the results of future explorations that the various kinds of mammals were actually set down upon a chart, a duplicate of which readers will enjoy seeing as a matter of scientific record. By this chart the reader will observe that in the original oracle of 1900 the home of the anthropoid apes, the chimpanzee, the orang, the gibbon and the gorilla, was placed in southern Asia—in India—as indicated by the word *Anthropoidea*, but that the home of the more remote ancestors of man, *Primates*, was placed in northern Asia, where our Expedition went to work.

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But we waited until the American Museum expedition of 1922 to verify the prediction of the palæontologist as to the homeland life of northern Asia. The verification came in that year with unexpected suddenness, but the successive explorations leading up to those of 1925, in which the ancestors of man were discovered in this very region, not only completed the original oracle far beyond our fondest hopes but also told another and a more ancient story of the Age of Reptiles, as set forth in this narrative volume by the leader of the Expedition.

Palæontology is the Aladdin's lamp of the most desert and lifeless regions of the earth; it touches the rocks and there spring forth in orderly succession the monarchs of the past and the ancient river streams and savannahs wherein they flourished. The rocks usually hide their story in the most difficult and inaccessible places. It was the genius of Roy Chapman Andrews not only to conceive the whole plan of these central Asiatic expeditions, but to carry out the plan with scientific thoroughness, with unalterable determination and with unflagging faith—a combination of qualities which inspired his entire party, insured his brilliant success, and aroused the enthusiastic interest of the civilized world.

HENRY FAIRFIELD OSBORN.

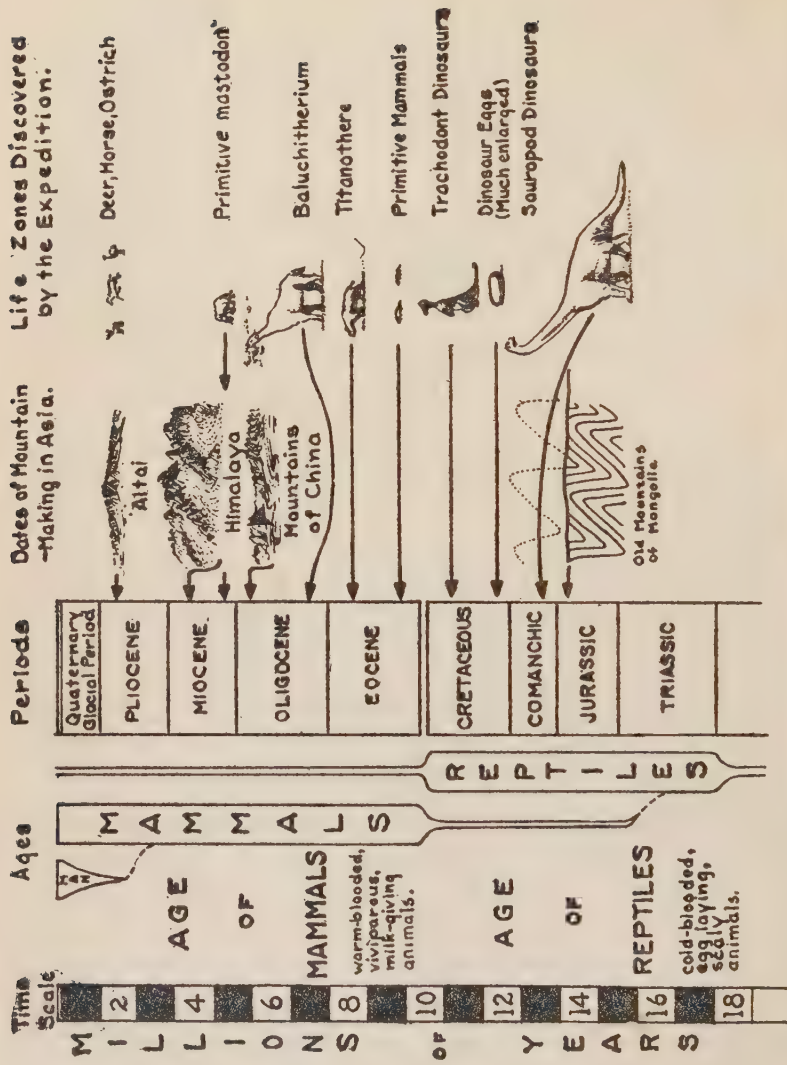
AMERICAN MUSEUM OF
NATURAL HISTORY,
February 25, 1926.



OSBORN'S PROPHETIC WORLD MAP OF 1899-1900.

In 1901 the ancestors of the Proboscidea (elephant family) were discovered by British explorers close to the point in North Africa which Osborn had indicated in 1900 by the word "Proboscidea."

Up to the year 1925 the Central Asiatic Expedition had discovered representatives of eight of the thirteen great Orders of Mammals, as prophesied by Osborn in 1900, in the Central Asiatic homeland, namely, the Insectivores, the Creodonts, the Carnivores, the Rodents, the Amblypods, the Perissodactyls, the Ancylopods, and the Artiodactyls. Leaving five orders still to be discovered, namely, the Cheiroptera (Bats), the Tillodontia (Tillodonts), the Tæniodonta (Tæniodonts), the Mesodonta (early Primates), and the Condylarthra (Condylarths).



Sketch of the general history of animal life and mountain formation in Central Asia, by F. K. Morris.

PREFACE

THE present book is a preliminary narrative of the field work of the Central Asiatic Expeditions. So many requests for a collected account of the activities of the expeditions during the last four years have come to us that we felt it was due the public to give the story of our experience in Mongolia up to the present time.

Since the field work has been progressing with only one interruption since 1921, and my brief visits to America have been occupied by lecture engagements and problems of finance and organization, it was impossible to find the time to prepare a book that should be considered definitive.

No attempt has been made to give the full scientific significance of our discoveries. Indeed, at the present time it would be impossible to do so for the study of the collections has only begun and hundreds of specimens are still encased in rock. The preparation of only the most important has been rushed to make them available for scientific investigation.

Fifty-four preliminary papers have been pub-

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lished in the *Novitates* and the *Bulletin* of the American Museum of Natural History. These put on record very briefly some of the most outstanding discoveries. When the field expeditions have been concluded in 1928, I expect to prepare a volume giving a popular account of the significance of the scientific work in all its branches.

Fourteen volumes of final scientific results have been projected. Volume II on the Geology of Central Asia by Professors Berkey and Morris is about to issue from the press. The maps made by Major Roberts in the 1925 expedition already have been published. The remaining volumes will be prepared as fast as the work can be concluded.

I wish to take this opportunity to express my personal indebtedness, as well as that of the American Museum of Natural History, to the generous Americans who have made the expedition possible through their financial support. Without their assistance, which has been given freely for the cause of science and education, with no expectation of material returns, the work could not have been carried on. The contributors number two hundred and forty-five, representing twenty-five states, thus giving a truly all-American character to the work. There was also one each from Switzerland, Porto Rico and Hawaii.

To my comrades in the field I owe a great debt of gratitude. No matter how completely the expedition had been organized and financed, it never could

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have been a success without the whole-hearted co-operation which every member of the staff has given. This splendid loyalty and personal support will remain forever as one of my most treasured memories.

I wish to offer thanks on behalf of the expedition and of the President and Trustees of the American Museum of Natural History to the governments of China and Mongolia for permission to carry on our field work in their dominions. Particularly are we grateful to Mr. T. Badmajapoff who rendered great assistance in obtaining our Mongolian permits. President Henry Fairfield Osborn has ever been our wise friend and counselor. Without his enthusiastic and continued support the expedition never could have gone into the field. It is not possible to mention by name all the individuals and organizations in China who have rendered us assistance, but I wish particularly to thank the Director and members of the Chinese Geological Survey and the Geological Society of China.

Drs. Ting, Wong, Andersson and Grabau have been our loyal friends and by their fine spirit of coöperation have maintained the highest ideals of international science.

The Director and staff of the Peking Union Medical College and the officers of the U. S. Marine Corps Detachment in Peking has rendered us innumerable courtesies.

To the Dodge Bros. Motor Corporation of Detroit,

PREFACE

Michigan, and the Fulton Motor Corporation of Farmingdale, Long Island, New York, we are indebted for much assistance, also to the Standard Oil Company of New York and the United States Rubber Company who put the facilities of their great organizations at our disposal.

I am greatly indebted personally to the editors of *Asia Magazine* and *The World's Work* for permission to use the material of the book which already has appeared in their magazines.

ROY CHAPMAN ANDREWS.

998 FIFTH AVENUE,
NEW YORK CITY.
February 21, 1926.

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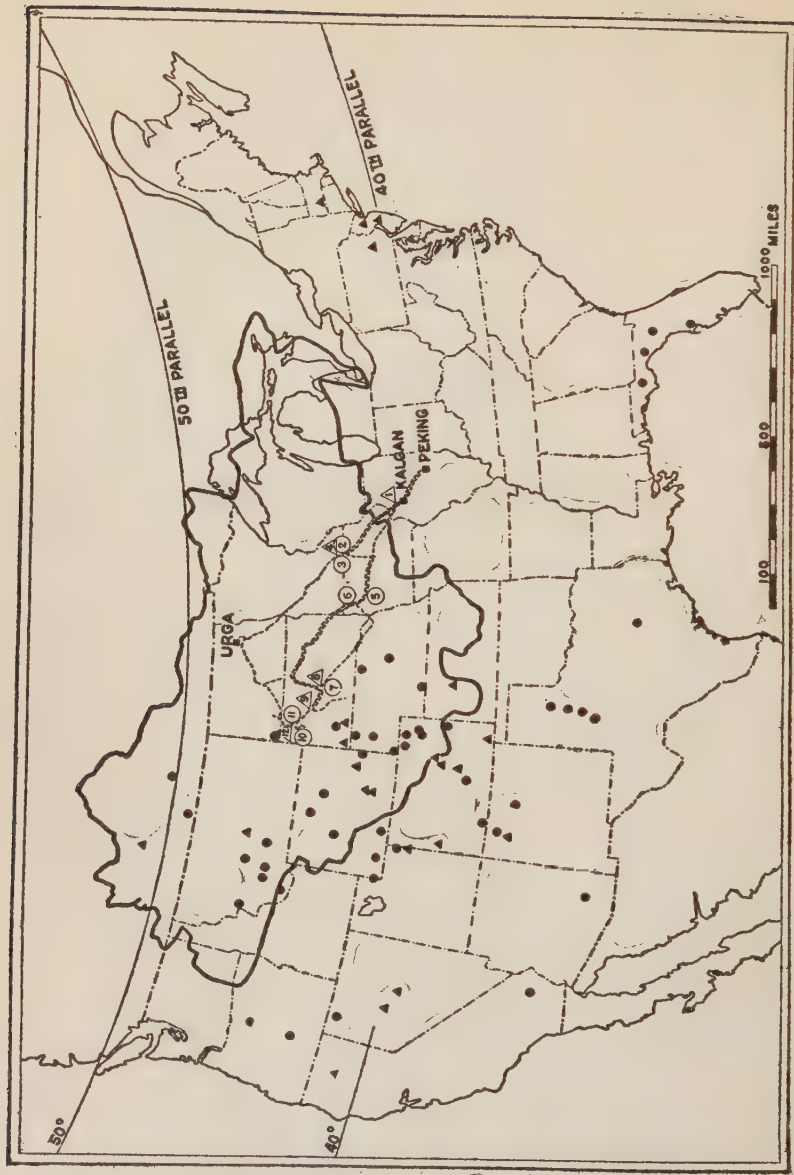


One of the fierce Mongolian dogs which eat the dead and attack the living.



Merin reading his own story in camp at Shabarakh Usu, 1925.

On the Trail of Ancient Man



Map prepared by F. K. Morris to show the comparative sizes of Mongolia and the United States.

On the Trail of Ancient Man

CHAPTER I

PREPARATIONS

EVER since 1912, when I began land exploration in Asia, Professor Osborn's prophecy as to the Asiatic origin of mammalian life had been in my mind, and the determination to test the theory became stronger as my travels and experience increased. With that ultimate end in view in 1915 I presented a plan to the President of the American Museum of Natural History for a series of expeditions which should extend over a period of ten years. They were designed to be purely zoölogical at first, and in the years 1916-17 the First Asiatic Expedition to Yunnan, Southwest China, and the borders of Tibet brought large collections to the Museum.

During 1918 I was in service in the World War and in 1919 spent the summer in Mongolia on the Second Asiatic Expedition.

ON THE TRAIL OF ANCIENT MAN

Every year I was becoming more and more impressed by the relationship of the living Asiatic mammals to those of Europe and America and realized how strongly this supported the theory of an Asiatic dispersal centre. Moreover, the fact that the Primates were considered to be of Asiatic origin and that there was a possibility of throwing light on human evolution made the plan which was gradually maturing in my mind even more alluring.

In all my work as a zoölogist I had felt the lack of expert knowledge in other branches of science. Often puzzling faunistic problems presented themselves which could easily have been solved if I had been a trained botanist. In Yunnan especially, glimpses of fascinating studies of the aboriginal natives, of fossils, geology, botany and geography were presented on every hand and yet I was unable to take advantage of them because I had neither the time nor the highly specialized training. Therefore, it was apparent that an effective attack upon the problems awaiting us in Central Asia could be made only by a *correlation* of the different sciences: *i.e.*, by a group of highly trained specialists all of whom were concentrating upon a single broad problem.

This was the ground plan upon which the Central Asiatic Expedition was organized, and it worked out in practice even better than it gave promise of doing in theory. Night after night as we sat in the mess tent discussing different questions

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which had arisen in the progress of the day's work, the stimulation and assistance given to each man by having expert knowledge in other branches of science upon which to draw was apparent. As far as I am aware the Central Asiatic Expedition is the only large expedition which has put this plan into actual practice.

Moreover I believe that this type represents the exploration of the future. Today there remain but a few small areas on the world's map unmarked by explorer's trails. Human courage and endurance have conquered the Poles; the secrets of the tropical jungles have been revealed. The highest mountains of the earth have heard the voice of man. But this does not mean that the youth of the future has no new worlds to vanquish. It means only that the explorer must change his methods.

We stand on the threshold of a new era of scientific exploration which is just as romantic, just as alluring, and just as adventurous as that of Peary and Amundsen, of Stanley and Hedin. In almost every country of the earth lie vast regions which potentially are unknown. Some of them are charted poorly if at all, and many hold undreamed of treasures in the realm of science.

To study these little known areas, to reveal the history of their making, and interpret that history to the world of today; to learn what they can give in education, culture, and for human welfare—that is the exploration of the future. It is even more diffi-

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cult than the task confronting the early explorers who brought to the world information of the broad topographic features of the countries they had traversed.

It requires even more careful organization and a wider background of scientific knowledge. Virtually all of the great expeditions for geographical exploration have included scientists who gathered what knowledge they could of the flora and fauna, of the geology and meteorology of the regions to be investigated. Special studies were limited by time and opportunity. They could do little more than bring back superficial information of the regions which awaited a more intimate study.

The intensive exploration of the future demands a different approach. With a broad but very definite problem in view every branch of science which will assist in its solution should be brought to bear upon it *in the field*.

Puzzling conditions in geology are clarified by the palæontologist. The palæobotanist may be able to give them both assistance in determining climatic changes. The flora and fauna of the past and present are so closely interlaced that it is impossible to fully understand one without knowing the other. The topographer who produces accurate maps is essential to them all.

Such intensive exploration even if it be confined to pure science, inevitably produces economic results. Many of the little known regions of the world are

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rich in undeveloped resources which can contribute much to human welfare. The scientific explorer must lead the way, but commerce is never slow to follow in his footsteps.

To those who imagine that exploration has lost its romance, I may say that the qualities of courage and endurance, the willingness to undergo hardships and to face death, are just as necessary today as they were to the first man who struggled through snow towards the Pole or braved the sand-storms of the desert.

I have been asked why we chose Mongolia as the place to work. The reason was because I knew the country fairly well from two previous trips and believed it would be productive; also because I was convinced that we could use motors for rapid transportation. Had the same conditions existed in the remaining parts of the Central Asian plateau,—Tibet, and Chinese and Russian Turkestan—we might have begun work there with equal hope of success.

Although Mongolia had been crossed and re-crossed by excellent explorers, mostly Russian, virtually no part of the country had been studied by the exact methods of modern science. Four primary reasons were responsible for this condition:

First, Mongolia is isolated in the heart of a vast continent and until recently a considerable journey was required even to reach its borders.

Second, the distances are great and transportation

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slow. Superimposed upon a map of the United States with its easternmost tip at Washington D. C., the western end of Mongolia extends beyond the Great Salt Lake and almost touches the Nevada line. It reaches as far south as Austin, Texas, and on the north halfway across North Dakota. In all this vast area there is not a single mile of railroad. Transportation is by camels, horses and ox carts. In the Gobi Desert which extends from west to east through the heart of Mongolia camels alone can be used throughout the year. A camel caravan moves at the rate of only two miles an hour and when conditions are good travels fifteen or twenty miles in a day.

Third, the climate is very severe. During the winter the temperature drops to forty or fifty degrees below zero and the plateau is swept by bitter winds from the Arctic Ocean. Then, most types of scientific investigations are impossible, for bare existence demands the strongest constitution. Effective scientific work can be conducted only from April to the end of September.

Fourth, in the Gobi Desert which occupies a large part of Mongolia food and water are scarce and the region is so inhospitable that there are very few inhabitants.

After analyzing these difficulties it was obvious that some means of rapid transportation would largely solve them and that without it an expedition of high-powered men, such as I had in mind, could

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not be carried out successfully. I believed that the automobile was the answer to the problem.

In 1918, when motors were new on the road, I had driven a car from Kalgan to Urga and returned. Then, it was considered something of an adventure, but by 1920 there was a regular service conducted by Chinese and foreign companies and the trip had become commonplace to an explorer. Between Kalgan and Urga the road is fine and hard, there are no serious streams or marshes and little sand of consequence. Moreover, if an accident does happen other cars pass so frequently that assistance usually can be obtained. In the far west where the Gobi is a real desert, where there are mountains and rivers, sand and rocks, it is a different story. There are no garages just around the corner—in fact there are no corners.

Nevertheless from what I knew of the country I was convinced that a properly equipped motor expedition supported by a camel caravan could operate successfully. And if it could, we would be able to do ten years' work in five months. I needed all the courage of my convictions, for, when it was announced that we intended to explore the central and western Gobi Desert with five cars, two of them one-ton trucks, and had planned a three thousand mile journey, even those men who had driven to Urga many times said that I was a little less than a fool. They advanced dozens of reasons as to why such a project could not succeed. But in my opinion

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everyone of them were answerable on the ground of preparation and organization.

As a matter of fact, the most frequent objection was that it had not been done. It was rather comforting therefore to think of the remark made by a prominent man who said that often it is well known that a thing is impossible. Everyone is sure that it can't be done. Then one day a fool comes along who hasn't heard that it is impossible and before he finds it out he goes ahead and does it!

When it came to a choice of cars opinion was strongly in favor of several well known Italian and French makes, but since this was an all-American expedition I felt that American cars were good enough for us. After careful investigation I chose the Dodge Brothers cars of Detroit, Michigan, and the Fulton one-ton trucks made by the Fulton Motors Corporation of Farmingdale, Long Island, N. Y. It was imperative to have light motors with a high clearance, very strongly built and with sufficient power to pull through sand. Those which we used were stock cars with no especial equipment. When the fleet arrived in China I asked virtually every insurance company for protection only against total loss. We had mechanics and spare parts enough to repair any reasonable breakage but it was conceivable that a car might be completely wrecked by falling over a cliff, by fire or some such catastrophe. I argued that the moral risk was good because we certainly would not abandon a machine unless it was

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absolutely necessary in view of the fact that the success of the expedition, if not our actual lives, depended upon the motor transport.

But the insurance companies could not see it in that light. They said the risk was too great. There was no precedent, and that we were lucky to have a supporting caravan for we would return on camels if we ever got back at all. No offers of attractive premiums could induce them to change their minds. Even after the first season they said we "were lucky" and probably couldn't do it again.

The success of the motor transport is shown by the fact that we used the same Dodge Bros. cars and Fulton trucks for two successive expeditions: that we travelled more than six thousand miles with the entire fleet over a virtually unknown country and the Dodge Bros. cars did as much as ten thousand miles: that when we returned, within three days I had sold all the motors as they stood in Kalgan, with no repairs, for more than they cost in America and that the same fleet continued to do service on the Kalgan-Urga run, in the hands of a Chinese company. The record speaks for itself and all the men on the expedition are as proud of the cars as though we had manufactured them. We have a new fleet of the same make for the future work of the expedition.

We were offered discouragements in our scientific programme as well as in the motor transport. It was pointed out that with the exception of a single rhinoceros tooth no fossils had been found in Mon-

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golia; that it was a waste of sand and gravel and that we might as well search in the middle of the Pacific Ocean as expect to find fossils in the Gobi Desert. Also, I was told that it was little short of criminal to take such eminent geologists as Berkey and Morris to a country where the rocks were obscured by grass or sand.

My feeling was that the men who had explored Mongolia in the past had not been able to use the modern methods which we intended to inaugurate and that, excellent as their work was in some respects it afforded no criterion as to what Mongolia would yield to our scientists.

My experience in the Orient had taught me that time and money were two of the greatest essentials for success and I made up my mind that I would not leave America unless both were assured. Five years for the work and a total of \$250,000 was what I believed to be the minimum.

When I returned to New York early in 1920 and presented my plans for the expedition to Professor Osborn, he gave them the same enthusiastic endorsement and support that I always have had from him. Without his active coöperation nothing could have been done and it is impossible to express the gratitude which I owe him personally and on behalf of the expedition.

At his suggestion I endeavored to interest the American Asiatic Association and its official organ, *Asia Magazine*. The editor of *Asia*, Mr. Louis D.

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Froelick, became one of my most loyal supporters and when I look back upon the many conferences that we held in his office I realize how freely he gave his time and thought.

As every explorer knows, the effort and nerve strain involved in financing a large expedition far surpasses the difficulties of actual field work. I would say nothing about this part for, I suppose its interest is largely personal, had I not discovered that at least nine out of ten people believe that the funds for such an expedition are all provided by the institutions under whose auspices it is launched. The prevailing idea seems to be that all the leader has to do is to take command in the field. Would that it were so! Were it true doubtless there would be many more explorers.

The Museum did what it could but most of the \$250,000 had to be obtained from private individuals. By the time we left New York for China late in February, 1921, I felt as though ten years had been clipped off my life. I had spoken at so many dinners and luncheons, lectured before so many audiences, interviewed so many financiers, talked so much and written so much about the Central Asiatic Expedition that it had become a veritable nightmare. Nevertheless, there were many pleasurable sides to the experience which I wish there had been more time to enjoy. I learned that the average American financier is an adventurer at heart. Making his money has been an adventure

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and he wants an adventure in spending it; he likes a sporting chance and exploration if it has a worthwhile object appeals to him.

Never will I forget the morning I went to see Mr. J. P. Morgan. I suppose every American who wants money for a public enterprise thinks first of either Mr. Morgan or Mr. Rockefeller. Mr. Morgan received me in his magnificent library on Thirty-third Street and for fifteen minutes I told him of my plans and hopes. I had a map of Central Asia with me. It is characteristic of him that he asked only a few questions but every one was straight to the point. "How can you get there? What do you expect to find there?" and a few others.

When I had finished he swung about, his eyes brilliant with interest.

"It's a great plan," he said. "How are you going to finance it? What do you want me to do?"

I wish Mr. Morgan could realize what his faith meant to me as well as his generous financial support, for it was at the very beginning of my efforts to raise money for the expedition. In the later months there were many discouragements as well as many successes but I never will forget that beginning.

I consider it a pretty good record for the American people that they were willing to finance an expedition which was based purely on a theory. I tried to make it clear to everyone that we were playing an "off chance" in the scientific race; that the dividends would be large if we won, but that the results might

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be entirely negative. In the first three years it was really a New York City expedition, for with the exception of one contribution from Wilkesbarre, Pa., every dollar came from New York.

The organization and equipment of the expedition had to be carried out simultaneously with the efforts to finance it. Of course selecting the staff was the most important and most difficult single task. The general fitness of a man for the job as well as his scientific training needed to be carefully considered, for personality, character, and the ability to get on with other men determine the success or failure of such an expedition as much as any other factor.

The Second in Command and Chief Palæontologist was an easy choice. Years ago I had told Walter Granger, Associate Curator of Fossil Mammals in the American Museum of Natural History, about my plans and he had promised to go when the time came. We had been colleagues for fifteen years; his field experience covers twice that time and as a fossil collector and a friend he is second to no man in the world.

Since we could not predict where our search would lead us in Mongolia it was necessary to have a camel caravan carrying supplies of food and gasoline. This would give us a movable base and could be shifted from place to place as conditions demanded.

It is impossible to get any food in the desert other than meat and animal products so that everything

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had to be taken with us. I selected the food with a great deal of care to give a varied diet and even at the end of the summer there were very few days when we did not have sufficient dried fruit and vegetables to keep us satisfied and in splendid health.

To carry our supplies we made boxes with sliding tops. As the food was exhausted we packed the fossils and other collections in these containers because there is no wood of any description to be obtained in the desert. Each camel carried four hundred pounds.

Through the courtesy of the Standard Oil Company of New York we were supplied with 3,000 gallons of gasoline and 50 gallons of oil for the first expedition and when this was packed we found that it required seventy-five camels to carry our total supplies.

With the assistance of Mr. F. A. Larsen we purchased the camels. The caravan could only travel at the rate of $2\frac{1}{2}$ miles per hour and it was necessary for them to leave considerably in advance of the motor party. I instructed the caravan to follow the Kalgan-Urga trail and await us at Tuerin, a monastery 550 miles from Kalgan. The caravan started five weeks before the rest of the expedition.

I knew that it would not be possible for the scientific staff to remain together during all the time that we were in field if they were to carry on their separate investigations to the best advantage. Therefore the motor party was divided into three units—each one complete with its cook, Mongol interpreter,

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tents and other equipment. Any of these units could maintain itself independently of the main party for a considerable period. Results prove that this plan was invaluable and is the only one that can be followed where scientific work of a diverse character is to be carried on without loss of time.

When the plans of the expedition were made public the world press seized upon the possibility of our finding primitive human remains as a feature of rare news value. We were somewhat appalled to find that we immediately became known as the "Missing Link" expedition and that the broad scientific aspect of our intended work was entirely lost.

At first I was indignant, but my protests were futile. Moreover, it did have the advantage of creating an enormous public interest which otherwise certainly would have been lacking. Also, it brought thousands of applications to join the expedition. These caused a vast amount of labor, for the staff already had been selected and most of the applicants wanted non-technical positions. It was impossible to explain to everyone that all camp work could be done better and cheaper by natives who know the language and customs and could live on simple food, than by white men, no matter how good they were.

The letters poured in at such a rate that I could not read them. Sometimes we had as many as a

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hundred a day and scores of people came in person to the Museum. My secretary, Miss Agnes Molloy, saw most of them and sorted and read all the letters. Some were amusing beyond words and I told her to save those to show me at the times when I was so tired that I had either to laugh or cry.

When the plans were first announced in the New York morning papers an artist who lived fifty miles from the city was so anxious to offer his services that he hired an aeroplane and flew to the American Museum of Natural History when he found that no train would get him there until after luncheon.

A lady in St. Louis telegraphed "Regarding search for 'Missing Link' ouija board offers assistance."

About three thousand applications were from men and boys. Ex-army men, flyers, outnumbered the rest. Most of them began "I can't settle down to office work after the war, I want to get away where I can have some excitement."

There were nearly a thousand from women. The real gem of the collection was one of the first to arrive. One day I heard my secretary exclaim under her breath, when examining the mail, "Why, the *idea*." Then she remarked, "I don't know whether you will consider this amusing or not, but you had better read it and here's the photograph."

The letter was from a woman who said, "I have already written two books but they haven't been accepted yet. I want to get material for a third—something *occult* and *stirring* and I think I can find

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it with you. I could go in a secretarial capacity for I have seen your picture in the newspapers and I am sure that you know how to treat a lady. But even if you don't need a secretary there are many other things that I can do. Perhaps I could go just as a 'woman friend.' I could create the 'home atmosphere' for you in those drear wastes. I am enclosing my photograph, but could you not have tea with me some day when your work is done? After you have seen me I will leave it with you to judge."

The newspapers did a good deal for us in the way of publicity but I am afraid I disappointed them grievously in one particular. They hoped for some thrilling stories of the dangers and hardships that we would encounter in the Gobi Desert and when I said that we did not expect to have either they seemed to think that it could not be a real exploring expedition. An explorer *must* have adventures! They are what the public expects!

There are many so-called explorers who are really travellers seeking adventure. They welcome every opportunity for a hair-breadth escape or some thrilling experience because it is their stock in trade. When they return they write a book about their experiences. Not having a serious objective in their wanderings which gives them something definite to contribute they tell the story of their hardships.

My friend, Stefansson, the Arctic explorer, has a motto, which I am very fond of quoting because it

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expresses a great deal in a single sentence. He says, "Adventures are a mark of incompetence."

If the explorer has a clear-cut problem to solve, and an honest desire to contribute something of worth to the world's knowledge, he will prepare against adventures. It will disappoint the newspaper but facilitate his work. How infinitely more creditable it is to eliminate difficulties through foresight and preparation before they are encountered than to suffer heroically and leave the work half done.

The explorer must first assimilate everything that has been written about the region he is to visit, or surrounding areas. Thus from the experience of others he knows the general conditions to be encountered and what is the best method of preparation. He can study his problem, plan it out on paper, get the best equipment, and above all the men who are fitted physically and mentally for the job. Then so far as human foresight can go, he is prepared to meet and overcome the difficulties which he knows will be encountered. After that he must trust to his own ability to solve those problems which could not be foreseen and prepared for.

For the last fifteen years I have spent most of the time wandering into the far corners of the world. During the first eight years I was studying and collecting whales and was at sea a good deal on tiny whaling vessels. Then I gave up that work and began land explorations in Asia. In the fifteen years I can remember just ten times when I had

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really narrow escapes from death. Two were from drowning in typhoons, one was when our boat was charged by a wounded whale; once my wife and I were nearly eaten by wild dogs, once we were in great danger from fanatical lama priests; two were close calls when I fell over cliffs, once I was nearly caught by a huge python, and twice I might have been killed by bandits.

Ninety-nine out of every hundred persons think that hardships are an essential part of an explorer's existence. But I don't believe in hardships; they are a great nuisance. Eat well, dress well, sleep well, whenever it is possible is a pretty good rule for everyday use. Don't *court* hardships. Then you can work hard and steadily and if a bit of "hardship" does come along in the course of things, you are ready to take it in your stride and laugh while it is going on. If you ask the members of the Central Asiatic Expedition about their hardships they will laugh at you. We seldom had any, and yet we were exploring a desert where there was virtually nothing to be obtained to eat except meat. We had twenty-six men in the field for two years and no illness. Could you equal that in New York?

All the equipment for the expedition with the exception of food and tents I purchased in New York. In the eighteen tons which were sent to Peking we had every modern invention for camp comfort. Because it is impossible to get vegetables of any kind in the Gobi I brought a quantity of dried onions, toma-

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toes, carrots, spinach and beets from America, but all the other food was obtained from the American Legation Marine Corps Detachment through the courtesy of Colonel H. Dunlap and Lt. Colonel Seth Williams.

We used Mongol tents and fur sleeping bags. Almost all explorers find that the natives have devised the best dwellings and the best clothes for their particular country and the conditions of life which it involves. The Mongols are no exception to this rule. They are nomads who are constantly moving as they follow their flocks or the dictates of their restless spirits. A permanent dwelling would be of little use for the grazing may be good at a certain place one year, but poor the next. Wind and cold are the most serious weather conditions to be met, they need not be worried about rain for even in the grasslands this seldom comes. Therefore, the tent which will stand against almost any Mongolian wind storm is made of double cotton cloth, light in weight, but is not particularly waterproof.

The sides sweep down to the ground from the ridge pole in long curves which present sloping surfaces to the wind at every possible angle. Thus if the tent is firmly pegged it cannot be blown down. The cloth may rip but it will still remain standing. Also, it can be erected in a gale when it would be impossible to pitch a wall tent. Under normal conditions a man can put up a small Mongol tent alone. First one entire side is pegged down; then the ridge and

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poles put in and with a rope the tent is pulled upright. It will stand in position while the other side is fastened.

Sheepskin sleeping bags and fur clothes are an essential for even in the summer the nights are cold and the rapid changes from winter to summer are amazing.

When we went into the field in 1922 every item of equipment and organization had been considered and we felt that we had prepared as far as it was humanly possible to do, for our Great Adventure.

CHAPTER II

SOME PRELIMINARY DIGRESSIONS

WE could not consider work in Mongolia during the first summer because it was necessary to make the diplomatic arrangements, and get the complicated machinery of such a large expedition under way. Therefore I sailed in advance of the main party.

Not since 1900 had there been such a storm as that which ushered us into Peking on the 14th of April, 1921. The dust reached as far south as Shanghai and its yellow blanket hovered over the sea sixty-five miles beyond the coast. It came from a land parched by fourteen well-nigh rainless months which had cost a heavy toll of human life.

We could hardly see the great Tartar walls as the train came into the station and for days after our arrival the air was like a London fog. The Chinese are very superstitious and we were told that no good could come from a summer which began with such a dusty spring. It was a bad omen—it meant famine, war, disease and death!

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Curiously enough the foreign community is always more or less affected by the Chinese superstitions, and we were greeted with a flood of rumors; Peking was certain to be attacked and looted—even the day and hour had been set—it was impossible to go into the interior, smallpox was raging, it would be dangerous to do this and dangerous to do that!

It was the same dear old hysterical Peking! We are rather a small community here and we *must* have excitement. If no political bomb is ready for explosion, something must be manufactured to furnish conversation at the Club and on the roof garden of the new hotel. So with dust, war, and smallpox we felt that the summer was beginning rather well.

My spirits rose accordingly and I was more than ever sure that in spite of all the predictions the Central Asiatic Expedition would be able to carry on its work without great difficulty. The dust would not last forever, proper precautions could be taken against smallpox, and as for war—well, the closer one gets to trouble in the interior the less impressive it becomes!

I was fortunate in finding an ideal house for the headquarters of the Expedition. Its former tenant, my old friend Dr. G. E. Morrison, was one of the best known Britishers who has ever lived in North China. His magnificent library, his brilliant writings for the *London Times*, his fascinating personality and his interest in science and exploration made his house a Mecca for travellers of every national-

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ity. I like to think that Dr. Morrison would enjoy seeing the house that he loved so well dedicated to this work.

When we arrived, the great doors which had been closed since Dr. Morrison's death were opened to admit carpenters, masons and other laborers, and to allow motor-trucks, laboratory supplies and boxes of equipment to pass into the sun-lit space of the outer court. Inside the tiled walls surrounding the compound we had the living quarters, garage, stables, equipment rooms, laboratories and motion picture studio—a small city of our own devoted to the multiple interests of the expedition.

Immediately upon arriving in Peking I visited the Geological Survey of China. I found the Director, Dr. V. K. Ting, Dr. Wong, Dr. Andersson, Dr. Grabau and all the other members of the survey, most cordial in their reception and anxious to give us the benefit of their experience in beginning our work.

The Survey had a comprehensive and well-advanced plan for their palæontological investigations embracing certain provinces in which they had already begun preliminary explorations. If we invaded these areas it meant unhealthy competition and a duplication of results which would at once be discourteous and unscientific. Asia presents such vast unexplored fields that there is room, not only for two institutions to carry on work, but for dozens of them. Therefore we arranged for a division of territory in which certain regions would be

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left entirely to them and others in which we could work without competition. This arrangement has proved to be admirable and there has been mutual assistance and coöperation during all the years that the Central Asiatic Expedition has been in the Orient.

Since it was impossible for us to consider Mongolia for the first summer, and highly desirable that our staff receive some preliminary training in the methods of work in China, the Geological Survey very kindly offered to turn over to us a locality at Wanhsien in Eastern Szechuan, which promised to yield interesting fossils. It was an excellent place in which to begin work for it was near the Yangtze River, above the gorges of Ichang in a region known to abound in caves. This great river valley had undoubtedly been a highway of travel for untold centuries and since the caverns would furnish excellent dwelling-places, it was not improbable that remains of primitive human beings might be found there.

Palæontological investigation in China is not easy because there is a combination of commercial and religious difficulties to be surmounted.

Fossils of all sorts have a highly commercial value to the natives. They are called "dragon bones" and when powdered, dissolved in acid and mixed with a liberal quantity of superstition, are of undoubted efficacy as a medicine for every kind of illness, from rheumatism to gun-shot wounds. The

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apothecary shops carry on a considerable trade in fossils, and if a Chinese discovers a fossil-bearing locality, he guards it as if it were a gold-mine. Foreigners often find it impossible to obtain permission to examine some of the long-worked beds that for centuries have been bequeathed by one generation to another.

Belief in "*feng-shui*," the "spirits of the earth, wind and water," which guard all burial places in China, is another active superstition which offers a serious obstacle to scientific work. Since in many thickly settled regions it is difficult to find a spot so far away from a grave-site that *feng-shui* is inoperative, the fossil-hunter must be extremely cautious in digging without having first obtained the consent of the nearest villages. He needs unlimited patience, great tact and a saving sense of humor.

Dr. J. G. Andersson, of the Chinese Geological Survey, who is a pioneer in palæontological collecting in China has had so many amusing experiences with the natives that they would fill a book. Once when he had gone through all the necessary formalities of obtaining the owners' permission to excavate, his operations were halted by the sudden appearance of an irate old lady. Angry men are bad enough, Heaven knows, but when a Chinese woman works herself into a frenzy, every one hunts cover. This particular old lady was so enraged that she seated herself squarely in the hole that the palæontologist had dug and refused to move. Argu-

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ments were useless. Andersson could not well shovel her out except at the risk of having his face scratched; so being a very tactful gentleman, he tried making her ridiculous. Since it was a hot day he borrowed an umbrella and gallantly held it over her head while the onlookers hugely enjoyed the joke. But the old lady comfortably settled herself and screamed even louder. Then Dr. Andersson bethought himself of his camera, an instrument guaranteed to make any Chinese woman "step lively," for she hates to have a foreigner photograph her.

Dr. Andersson politely explained to the spectators that without doubt the old lady would like to have her picture taken while she was sitting in the hole. This was too much! Before the camera could be focused, she leaped out, screaming with rage. But even though she had been routed from her strategic position, she eventually won the battle; for she continued to create such a disturbance that Andersson's native assistants advised him to retire, leaving the enemy in possession of the field, at least until the smoke of battle had lifted.

I engaged as helper for Mr. Granger in his first palæontological adventures and as official interpreter of the expedition, Mr. James Wong, a young Chinese student educated in an American military academy and possessed not only of extraordinary energy and ability but of a charming personality as well.

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Though Mr. Granger and I had decided to accept the courteous offer of the Chinese Geological Survey and to make the Wanh sien locality in Eastern Szechuan the first point of palæontological investigation, I should have hesitated to ask a man less cool and determined than Granger to visit so disturbed a region as the Yangtse Valley on his first trip into the interior of China. The fact that he carried on his work without serious difficulty for two winters speaks for itself. A letter from him under date of September 27th, 1921, tells of his initial trip to Wanh sien:

“Our journey from Ichang to Wanh sien was interesting and exciting. At Ichang we ran right into one of the inter-provincial wars and had a chance to watch from our decks, or from our state-room windows, quite a lot of fighting on the hills opposite the town. It was necessary to transship there, and I managed to get my equipment into one of the steamer godowns before the close-in firing broke out; then managed to get it out again before the up-river boat arrived.

“The *Lung Mow* left Ichang at day-break, the city being still in the hands of its defenders and by breakfast time we were in the first Ichang gorge. A British American Tobacco Company's man from Nanking and I were sitting on the observation deck, admiring the really magnificent cliffs and congratulating ourselves that, at least we were above the turmoil of war when, suddenly there appeared ahead of us a junk-load of Szechuanese soldiers coming down river, and bang! one of them took a pot-shot

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at us. The steamboat siren blew a warning and we had to go below; four times I was chased off the deck and finally got tired of it and stayed below on the saloon-deck. Even then, later on in the day, when the firing began to get on the crew's nerves, we were several times ordered below where we had the protection of the steel hull of the ship.

"About every junk-load of soldiers we met took at least one try at us. I don't know how many hits they made, but one bullet slipped in past four of us who were sitting on the after-deck, went through the paneling into the dining-saloon and fetched up on the linoleum flooring.

"The trouble is that the river boats make such a heavy wash that junks are sometimes sunk and every load of soldiers lost in this way makes just one more black mark against the up-river boats, and there have been several such losses recently. . . .

"The steamboats in going up stream always slow down when meeting junks, but in coming down they must maintain a steering headway and it is thus that most of the sinkings occur. There are warning signals on shore at all danger points, announcing that steamers are approaching from above or below, but the junks mostly ignore these signals and trouble ensues.

"The steamboats are going to continue to go up and down wherever the stream is navigable and soldiers ought to realize this after a while. There is no sense in transporting soldiers on the river anyway. If the Szechuanese would stay where they belong everything would be serene.

"Coming up river I was reminded of a book I have seen on sale here in China—*Glimpses of the Yangtze Gorges*. That is what we got! We reached

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Wanh sien at noon on the second day and I was at once welcomed by Mr. Asker, the Commissioner of Customs who asked me to make my headquarters at his place, which is a large temple on the outskirts of the town."

Mr. Granger discovered that all the fossils came from near a small village called Yenchingkao, ten miles from Wanh sien. He made his camp in a temple at the village and for two winters carried on his work by buying specimens from the natives. His first letter under date of December 26th, 1921, describes the unusual methods of collecting.

"The fossils at Yenchingkao occur in pits which are distributed along a great limestone ridge some 30 or 40 miles in length and rising above our camp over 2,000 feet. These pits are the result of the dissolving action of water on limestone and some of them have a depth of one hundred feet or more. They are of varying sizes—averaging say six feet in diameter—and are filled with a yellowish and reddish mud which is, I take it, disintegrated limestone. The fossils are found embedded in the mud at varying depths, usually below 20 feet. A crude windlass is rigged up over the pit and the mud dug out and hauled to the surface in scoop-shaped baskets. At fifty feet it is dark in the pit and the work is done by the light of a tiny oil wick. It is fossil collecting under the most adverse conditions imaginable.

"The excavation of the fossils has been going on for a long time—possibly some generations—and it

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is a considerable business. Digging is only done in the winter months.

"One has to be let down with a rope around his waist and with two or three men at the windlass. The natives climb up and down the rope hand over hand, but it requires practice and agility to do this. You'd be shy one palæontologist if I tried to do it!

"The excavation of the pit is opening up just now on a large scale and in the coming month will probably give us about all that we can take care of. The fauna is *Stegodon* (elephant), *Bison*, *Bos* (cow-like animals), *Cervus* (deer), *Tapirus* (tapirs), *Sus* (pigs), *Rhinoceros* (rhinoceros), besides many small ruminants, several carnivores, large and small, and many rodents; no horses queerly enough."

Until Dr. J. G. Andersson began his splendid work with the Chinese Geological Survey, knowledge of the palæontology of China rested almost entirely upon Schlosser.¹

All Schlosser's material was purchased in the drug shops and consisted of teeth and fragments of bones. It was impossible to get accurate information as to the localities where it was obtained and it is amazing that his work should have proved to be so good. Thus, when Andersson began to discover fossils *in situ* he had a virtually untouched field before him. From his work and that of Schlosser's there was evidence of at least two distinct faunas in North China, probably separated by the Tsingling mountains of

¹ *Die fossilen Säugethiere Chinas* (Munich, 1903).

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Shensi. To the north is the so called *Hipparion* fauna, characterized by an abundance of horses. To the south is what we have named the *Stegodon* fauna, for the remains of these primitive elephants are common.

The Chinese Geological Survey has entirely confined their work to the *Hipparion* beds and we hoped that their Wanhsien locality would give us something entirely different, as indeed it did.

It is disappointing that Mr. Granger has not been able to investigate the caves along the banks of the Yangtze River where we hoped the remains of primitive human beings might be found. Although he spent the two winters of 1921-1922 and 1922-23 at Wanhsien, the region which contained the caverns was so infested with bandits that it would have been extremely hazardous to attempt a survey of it.

Dr. W. D. Matthew, curator of Palæontology in the American Museum of Natural History, who has studied Granger's Szechuan collections, has come to the conclusion that the fauna as a whole indicates forest conditions in this region during the Pleistocene or Ice Age. Granger's collection is composed partly of species identical with those still living in the surrounding mountains and partly of mammals whose nearest relatives are in Malaysia. It is extraordinarily interesting because it gives an accurate picture of the animal life of the region at the time of man's appearance in Central China, and before it had been depopulated by human agencies.

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That Old Stone Age man was contemporaneous with these animals which had fallen into the wells and become fossilized is definitely shown by a stag antler, two tines of which had been hacked off with a stone implement. It is highly probable, therefore, that we may discover human bones at any moment, although, because of his superior intelligence, Palæolithic men would not fall into the wells as frequently as the lower animals. Nevertheless some of them must inevitably have met death in this way.

The primitive elephant, *Stegodon*, was the largest animal that roamed this region during the Ice Age, but it was hardly less spectacular than a giant tapir which was as big as a modern horse. That monkeys swung through the treetops, we know, because Granger has obtained both gibbon and langur skulls from the pits.

Just before we started field work Dr. J. G. Andersson had a piece of good fortune which shows how excellent are the prospects for making important discoveries in the realm of ancient human history.

He was to go on a short expedition to Manchuria and very kindly offered to take our interpreter, Mr. Wong, with him in order to give him some preliminary training in fossil hunting which would be of value in his work with Mr. Granger. On this trip Mr. Wong almost immediately discovered a bone deposit in the floor of a cave which contained parts of many human skeletons. Dr. Andersson had already

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found a similar culture in Honan and recently has brought back a wealth of early human material, pottery and artifacts from Kansu and the Koko Nor region of Tibet. Although this is post-Neolithic, nevertheless, it indicates what a rich field eastern Asia presents to the archæologist.

After Mr. Granger had started for Szechuan, I made a short expedition to the Eastern Tombs (Tung Ling), eighty miles from Peking. The object of the trip was to initiate Mr. Pope into the methods of reptile and fish collecting in China and to train several native assistants in the preparation of specimens. At the Tung Ling several of the Manchu Emperors and Empresses are buried in magnificent mausoleums which stand among some of China's most beautiful scenery.

To the north of the tombs, surrounded by a high wall, is an enormous hunting park about a hundred miles in length. This contains rugged mountains, sombre valleys, and great forests of birch, pine, spruce, and oak. It is an extraordinarily interesting region to the zoölogist because it stands as a "forest island" isolated by miles of treeless country.

In its fauna are many species of birds, reptiles and mammals which elsewhere exist only far to the south or in the great forests of Manchuria. Thus, there is strong evidence that in past centuries a more or less continuous wooded belt extended from the Yangtze River to the frontiers of Manchuria and across an area which is now bare plains or hills.

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That this beautiful, primeval forest, the last in North China, is being cleared as fast as ax and fire can do the work is one of the most disgraceful chapters of recent Chinese history, and I was sick at heart at the progress of destruction since my first visit in 1919. The beautiful valley where we had camped amid one of the most splendid forests I have ever seen, is now filled with fields of corn and millet—not a tree remains. The mountain sides are scarred with patches of waving grain almost to their summits. A few more years and this glorious spot, which should have been a national park, will be as bare of trees as are the other hills of North China. I like the Chinese farmer—he is the hope of the Chinese nation—but sometimes I hate his handiwork!

Our first camp was on the outskirts of a mountain village Hsing Ling Shan, and Mr. Pope, who has been accustomed to doing his own collecting, had a real surprise at the methods we use in China. Our tents were surrounded immediately by dozens of curious men, women and children. We encouraged their interest, for they were our potential collectors.

We told them that we would pay three coppers—about one cent—for every frog, lizard and toad that they brought us, and more for every snake. At first they were inclined to doubt. Why would anyone be fool enough to pay good money for something that he could not eat? After a little one or two of the more enterprising boys disappeared and returned

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with several frogs. They presented them to us with evident embarrassment, as if expecting to be ridiculed by their friends, but when the spectators saw them promptly paid, the affair assumed a different aspect. We might be temporarily insane—probably we were—but at least we had money, and if we wanted to squander it that was our business. It was a Heaven-sent opportunity for quick profits on easy work, and above all things a Chinese is a business man. As a result, before the day was ended, specimens were pouring in faster than we could care for them.

During the week in which we remained at that camp a hundred men, boys, and girls were scouring the hills, fields and valleys, and dozens of others were industriously fishing in the little mountain stream beside our tent. When we had a sufficient quantity of the more common species we reduced the price or ceased buying altogether and offered a special premium for the rarer forms. We collected more than a thousand specimens, and left with a confident feeling that we had a complete representation of the fauna in the vicinity of Hsing Ling Shan. What those two or three hundred Chinese did not find for us must be very rare indeed!

Later in the summer Mr. Pope carried on his investigations alone in Anhwei Province and spent the winter of 1921-22 at the Tung Ting Lake, Hunan. In the summer of 1922, while the main expedition was in Mongolia, he worked in Shansi Province and

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then spent nearly a year in the little known island of Hainan, near Hong Kong.

The results of Mr. Pope's careful and enthusiastic labor already has produced by far the largest and most complete collection of reptiles, batrachians and fish that has ever been made in China. So little serious work has been done on these lower vertebrates that the field offers almost unlimited possibilities for original research. In every locality species new to science and interesting revelations in life histories await the investigation. Moreover, the work is of immense importance in helping solve the larger problems of zoögeography which have had a profound influence upon animal and human migrations.

Our plan is to have Mr. Pope continue his survey of the herpetology and ichthyology in every province of China. It is unfortunate that he could not participate in the Mongolian expeditions, but the reptile and fish life of the Gobi Desert is so limited that it would have been a waste of time and we have been able to obtain a fairly complete collection for him.

He has carried on his work at times under the most difficult and dangerous circumstances. In 1922 in Shansi on the border of the Ordos Desert, he was in a city which was captured by bandits. By his tact and courage he not only saved his life and collections but continued his work. In the island of Hainan it was highly dangerous to go beyond nar-

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rowly circumscribed limits because the region swarmed with brigands: yet he remained there a whole year and brought out a superb collection. I regret that it is not possible to give in more detail the progress of his work but I hope that he himself will narrate his experiences in a future volume.

CHAPTER III

HUNTING THE "GOLDEN FLEECE"

ONE of the objectives of the Expedition was to obtain the rare and typical large mammals of Asia for exhibition in the new Hall of Asiatic Life of the American Museum of Natural History.

As I am a zoölogist, that has been my particular work and on September 8, 1921, accompanied by Captain W. F. Collins, I left for the Tsingling mountains of Shensi Province to obtain specimens of the takin (*Budorcas bedfordi*). This species is the modern representative of the "golden fleece" and is one of the rarest and most interesting animals of the world. It was discovered by the late Mr. Malcolm Anderson while on the Duke of Bedford's expedition under the direction of the British Museum of Natural History.

Although takin of different species are found in the mountains of northern India and western China, the Shensi form has been killed by not more than seven or eight white men. Moreover, we wished to make a reconnaissance of the Tsingling mountains

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which extend east and west through the centre of China and appear to have been a faunal divide even in geological times as they are today.

This forested range never has been carefully investigated and offers one of the most attractive fields for zoölogical work both from the standpoint of discovering species new to science and from that of distribution.

To the Chinese, the takin is known as "yeh niu" (wild cow), and in truth it does resemble a cow superficially a good deal more than it does its nearest relatives, the chamois, Rocky Mountain goat, serow and goral. These animals form a strange sub-family, the *Rupricaprinæ* or goat-antelopes, so called because they combine characters of both the goats and the true antelopes. This is an excellent example of a group that, with its origin in Asia, has sent one branch, the chamois, to Europe, and another, so called the Rocky Mountain goat, to America.

Unlike the white rhinoceros, which is not white, and the blue fox, which is not blue, the takin of the "golden fleece" really is golden—in color at least. From the end of their enormous Roman noses to the tips of their abbreviated tails the Shensi animals are a beautiful golden yellow without a patch of darker color. I shall never forget the startling impression when, for the first time I saw a group of six of the great brutes, climbing about on a rugged mountainside amid a thicket of dwarf bamboos. The

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sun was shining full on their long winter coats, which blazed like molten gold among the dull green leaves. They wore the "golden fleece" as surely as if they had stepped out of the story-book of Greek Mythology.

On the way to the Tsingling mountains Captain Collins and I had to dodge a war which was in full operation about Sianfu, the ancient capital of China, but late in the evening, at the end of a fortnight's mule travel we stumbled into the little village of Lingtai-miao, at the foot of the Ta Pai Shan (Great White Mountain).

The village was a poor affair—only a straggling main street bordered by mud huts in which mangy dogs, pigs, chickens and goats lived on the most intimate terms with the human inhabitants. Until I saw the people themselves, I wondered how so wretched a place could exist amid those beautiful surroundings. Ordinary Shensi farmers are unprepossessing and many of them show the ravages of opium, but these mountain folk were even lower in the human scale.

Captain Collins and I found that the temple where we were camping lay amid golden-yellow rice-fields in a beautiful valley beside a brawling mountain stream bordered by straight white poplars. A few hundred yards away the foothills rose steeply, range upon range, into the grey cloud-veil low-hung about the summits of Ta Pai Shan.

We did not have the temple to ourselves, for a dozen village soldiers had taken up their quarters

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in the rooms on each side of the court. We spread our belongings at the foot of the altar in the main building, where a blear-eyed old priest had made himself a bed of straw in one corner. His duties consisted solely of keeping alight the tiny oil-wicks that burned at the feet of the gods, and of changing the bowls of food upon the altar. But he wore an expression of utter exhaustion and always retired at dark to sleep uninterruptedly until broad daylight.

On a beautiful morning we left the temple with eight bearers, carrying our food, collecting outfit and sleeping-bags. The way led up the main valley, and the rocky river bed gave us splendid pheasant-shooting. The birds were continually sailing down from the foothills for their morning drink. They were strong on the wing and seemed as plentiful as sparrows. Had we really hunted them we probably could have shot fifty in an hour. We killed nineteen pheasants, one hare and one woodcock without going more than a hundred yards from the trail.

When the trail turned abruptly to the east and entered a side valley, which rapidly narrowed to a canyon, climbing began in earnest and we passed through an interesting series of floral zones. The lower slopes of the mountain are thickly blanketed with a dense forest of birch, oak, poplar, spruce, and larch; at about six thousand feet the dwarf bamboo begins; above this is the rhododendron belt, extending to timber-line at eleven thousand feet. Above us,

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between the narrow walls of the gorge, we saw a ragged sky-line of green-clad peaks; beneath our feet was a chaotic mass of stones and boulders on the banks of a mountain torrent. The trail so frequently crossed and re-crossed the stream that we were in the water as often as out of it, and after a half mile or so we abandoned all attempts to keep dry. I firmly believe that the rain which falls upon the Ta Pai Shan and the streams that flow down its sides are the coldest in the world! It was dark when we climbed out of the trail to a huge rock wall, which rose sheer a hundred feet above us, leaving a narrow basal ledge. The men cut bamboos for beds, and we grouped ourselves about the fire, trying to dry portions of our sodden garments.

We were on a level with the lower peaks and above their summits could see snow-capped ridges shining whitely in the starlight. It was very still up there. Not even the roar of the stream reached our ledge: not a bird-note sounded in the night. In our fur-sleeping bags Collins and I lay propped against the rock face, smoking silently. The wildness of the mountains had stirred our primitive instincts. We looked upon our lot and found it good.

A two-hour climb in the morning up a slope so steep that we were well-nigh forced to go on all fours, brought us to a beautiful meadow, thick-carpeted with long brown grass. There, in a spot that appeared to have been a wood-cutter's camp years ago, we pitched our tents and covered a skele-

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ton of poles with grass and dwarf bamboo for the three men who were to remain as hunters.

Behind us the meadow met a rhododendron jungle, its brown grass giving place to dark green leaves, which spread up the steep slope of a ridge, over the summit and away into the peaks and chasms of far-off mountains. Harmless enough it looked, but we learned to dread the tangle of its thickly twisted branches. To the east a fearsome canyon cut us off from distant summits drifted deep with snow; to the west lay a tumbled mass of granite boulders, old and lichen-covered but some still poised, an avalanche that had fallen away from the cliffs above. It was a wild place, fit home for one of the strangest beasts of a strange land.

For two days we hunted without success in the region of the camp. Takin had been there years before but there was no fresh sign. While at breakfast on the third morning, we noticed one of the hunters, an old man, Liu by name, busily engaged beside a rock a few yards from the tent. He made himself a little shrine of grass and leaves and then produced a half dozen sticks of incense. These he lighted and with mumbled prayers and incantations kowtowed before his joss. We watched the performance with some amusement, but the hunters took it very seriously. At the end the old man announced that we certainly would find takin that day.

An hour later our hunters started eastward toward

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the snow peaks, skirting the upper end of the gorge, near camp and directly through the rhododendron jungle. Sinking into holes, bruising ourselves on hidden rocks, twisting, turning and crawling through the maze of ropelike branches, we followed them on what seemed to be a hopeless chase. At noon we dropped exhausted on the sun-warmed stones of a granite buttress which projected into the canyon.

We were hardly settled when Yong, one of the hunters whispered "*Yeh nui*" (wild cows) and pointed to a bamboo clad spur seven hundred yards away. I nearly slipped off the ridge in my excitement when I caught a glimpse of a yellow speck with another beside it. The glasses showed them plainly—huge golden-yellow brutes moving easily amid the bamboo jungle on a slope so steep that they seemed to be hanging by their horns.

Night after night I had had dreams of taking but they were never stranger than the animals I saw on that sun-lit peak of the Ta Pai Shan. Everything about them seemed unreal. They were not creatures of our world but they fitted beautifully into Greek mythology. I cannot imagine beasts apparently less adapted to live among the mountains and yet, there they were, on a peak so steep and rugged that I doubted that we could ever climb it.

We watched them for half an hour hoping they would settle themselves for the mid-day rest but they continued to browse upon the bamboo leaves always slowly moving upwards. The hunters as-

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sured us that we could not reach them and return to camp before night. We scoffed at that but for safety's sake sent two men back to the tents to bring our sleeping bags and a little food; then we began the stalk. It was necessary to circle about the upper end of the canyon into which the granite ridge projected, descend to the stream bed and climb the peak where the animals were feeding. It sounds very simple and it looked so to us, but that was the only simple thing about it.

The slopes we scrambled up and down were almost perpendicular and we had to fight our way through a bamboo jungle that was worse than the rhododendrons. The dwarf bamboo is only ten or fifteen feet high and the stalks are not larger than one's finger but they grow so close together that it is impossible to see more than a few feet ahead. It was only by main force that we could get through at all and the whip-like stems slashed us mercilessly until our hands and faces were torn and bleeding. To add to the discomfort a drizzling rain began and in half an hour we were soaked to the skin and shivering in spite of the strenuous work.

Somehow we got to the bottom of the gorge, made our way down the stream bed, half the time knee-deep in icy water, and started the long climb up the thousand foot peak where the animals had been feeding. When we reached their tracks there were no takin and we were nearly done. Yong said they had gone higher still.

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Collins and I had drawn for the first shot and the lot had fallen to me. I cursed my luck then, for the hunter assured me that the man who went up would get the shot; the other must remain below to intercept the brutes if they came down.

Collins perched himself on a rocky pinnacle and I went with Yong. We got to the summit just at dusk to find the tracks leading far back into the mountains. There was nothing for it but to descend and make the best of a wet night.

We could look across the canyon to our brown tents in the little meadow, less than a mile from us in a straight line but as unattainable as the stars. It had taken us nearly six hours of killing work to reach this peak where we had seen the takin from a point not more than seven hundred yards away. When we got to the bottom of the gorge it was black night and raining steadily. Fortunately the matches in my water-proof case were dry and we managed to start a feeble fire.

We were very low in our minds, not at the prospect of a cold wet night, but because we had nothing to eat for the morrow. We were both faint from lack of food and it seemed impossible to face another day of gruelling work without some nourishment. When we killed a takin we could feast on the meat, but the question was, could we last until the animals were found.

We had little hope that the men who had been sent back would find us, for it seemed absurd to think

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that any human being could travel in the dark where it had been well-nigh impossible to go in the daylight. Yet about ten o'clock we heard a rustling in the jungle and a moment later the two men whom we had sent back to camp appeared. I could have hugged Lao Chung (he was our own man) for they brought food and we could find the takin on the morrow. They had seen our fire and made their way down that treacherous stream-bed for more than a mile in thick blackness with only that tiny spot of light to guide them.

The sun was high the next morning before we reached the summit of the peak and picked up the takin tracks where I had left them the night before. They led up and back toward an amphitheater of higher ridges but the trail was fresh and plain. At eleven o'clock we struggled through a particularly nasty patch of jungle and sank down, utterly exhausted, upon the rocks in the sunlight. Both Collins and I were somewhat shaken for I had narrowly missed death a few moments earlier. While crossing a tiny ledge my shooting coat had caught on a spur and hurled me over the cliff. With one foot I landed on a projecting shelf, grasped three bamboo stalks and drew back to safety. Had they not been as tough as rawhide I should have plunged, head first, to the jagged rocks three hundred feet below.

After a short rest our men climbed out upon a granite pinnacle for a look about. Almost immedi-

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ately they returned, trembling with excitement. The takin were there—we could shoot them from where we were. It was a dangerous piece of work to reach the spot where the men had been. When we peeped over the edge of the rock I saw nothing but the bamboo jungle shimmering in the sunlight; then there was a slight movement far below and an animal emerged from the cover to stand quietly, gazing directly at us. It was small, I could see that, but Yong urged me to shoot and no others were in sight.

Holding well below the belly line, I fired. The beast plunged forward and pandemonium broke loose. I have no clear remembrance of just what happened for the jungle seemed full of charging forms and the wretched Yong to whom I had entrusted my second rifle started a mad fusilade almost in my ear. It was impossible for me to shoot and not until the gun was empty did he cease his futile bombardment. Only a sportsman can appreciate the enormity of his offense.

At the first shot the six takin that had been lying down leaped to their feet but only now and then could we catch a glimpse of a yellow form as it passed through an open space. It was downhill shooting at long range under the worst conditions possible. Collins worked his Savage rifle coolly but we found later had failed to kill a beast.

In less than a minute it was all over and Yong and I descended to ascertain the casualty list while

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Collins watched from above. We found my first animal, a nursing calf, with a broken back. A little below, Yong put up a full-grown beast which we thought had been wounded and I snapped at it uselessly as it dashed down hill. A moment later a cow leaped out twenty feet ahead of me. I fired quickly breaking a hind leg, but she kept on without a pause. Finally she stopped beside a tree and I shot through the bamboo tops dropping her dead in her tracks.

Although we searched the jungle carefully we found no other animals or signs of blood and came to the conclusion that the two which I had killed were our only bag. It was hard luck for Collins because he had borne the work without a murmur, like the true sportsman that he is.

Although I had wanted to shoot a takin more than any other animal in the world, the accomplishment left me cold. I was so utterly exhausted, physically, that my brain was numb; it could register only a feeling of relief that the hunt was ended. Had it not been for Yong we might have completed our Museum group in those few minutes. As it was we had only a mother and her calf but I did not doubt that we should get other adults to complete the family.

At two o'clock in the afternoon we started back to camp. With the load of skins and sleeping bags we could not go by the way we had come and even though our tents were less than a mile away in a straight line it was two days before we reached them.

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Collins and I spent the next day in selecting a spot with the proper background for the takin group, making photographs and collecting the grass, leaves, rocks and other accessory material.

We decided upon a steep cliff-side clothed with bamboo which led up to the kind of rocky ledge on which the animals love to sleep and sun themselves. The background was to be the peak where we had killed our specimens two days before. We took enough bamboo for the entire group, first brushing the stalks with weak formalin and then wrapping the bundle with burlap. Of the rocks we selected various samples with dried lichens attached and photographed the characteristic fissures and formations. In a solution of water, formalin and glycerine we preserved fresh sprigs of bamboo and grass from which plaster casts will be made and wax leaves prepared. It was a labor of love, for, in the not far distant future the scene which we were now viewing would be duplicated in the Museum under my direction.

While we were gone my Chinese taxidermist had been trapping industriously, and on our return he presented us with a trayful of mice, shrews and moles. Two I recognized as known only from a single specimen of each. Three others were undoubtedly new to science. The mountain was most surprising in its small mammalian fauna. Instead of one species that far outnumbered all the others, as is the case in most localities, here there was a

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great variety of species with no one predominant. The fauna of this region is so important and so little known that the Central Asiatic Expedition will make a careful study of the entire mountain range before we leave China.

Another day of hunting in the vicinity of camp demonstrated that it was useless to look for takin there. Collins and I decided to take three bearers with food and sleeping bags and strike into the mountains near the spot where we had killed the other "wild cow." The taxidermist was to continue work at the camp in the meadow until we sent him bearers from the village.

Halfway down the mountain we left part of our things in a cave, and with three light loads set off towards the snow-clad peaks where we were confident the hunt would end. It began to rain in the afternoon and we camped early under an overhanging rock. The weather of the Ta Pai Shan was a constant source of surprise. The sun always rose in a cloudless sky, but at any moment grey mist, accompanied by a drizzling rain, might steal in from above or below. Not a day passed without rain. It might be only enough to wet the bamboos, but that ensured a thorough soaking for us as we pushed through the thick bushes.

Our second hunt was a disappointment. We found fresh tracks and followed them days at a time hunting every inch of the forested peaks but never did we see an animal. Once, two of them were

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within fifty yards of us but they stole away noiselessly through bamboo so thick that we could barely move at all. How a beast nearly as large as a cow (for a full-grown takin weighs 500 pounds) could move quietly in that tangle was a mystery to us both.

At night we slept under ledges or overhanging rocks crawling into our fur sleeping-bags so tired that we could hardly cook our food; but in the morning we were always fit and ready for the day's work.

At last we awoke to a world white with new-fallen snow, and we knew that the hunt was ended. It would be utterly useless as well as very dangerous to climb those peaks while the snow remained. Our hearts were heavy as we went down the mountain toward the village for we greatly wished to finish the work we had begun.

I decided to leave my two men with instructions not to return until they had at least two more takin. We felt sure that they would have success, though it might be weeks before the snow melted sufficiently to make hunting possible. We had all the necessary data for the group and I was not needed; for the men were well trained and I could depend upon them to follow directions to the letter.

The hunt had been so difficult and exhausting that I doubted whether I should ever attempt to kill another takin. But even as I write, the charm of those rugged peaks, the great stillness and the lure of the wilderness is in my blood and I know full well that

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some day I shall return. Not, however, in the winter or summer months. Midsummer is the time to hunt Shensi takin. Then the animals are in the open on the very summits of the ridges, and it becomes merely a question of climbing high enough and preparing for lots of rain. With one exception the other white men who have killed takin have chosen the summer months and they had none of the difficulties that we encountered.

The takin has been so seldom pursued by white men that very little is known about its life history and we hunted the animals such a short time that it was not possible to obtain new information.

The natives told me that the rut begins early in August and that the calves are born the following spring in April. I feel sure that this is correct for we estimated the calf I killed (September) to be about six months old.

Takin spend the summer in the open on the highest peaks above the rhododendron forest feeding on grass, herbs, and shrubs. Were it not for the continual rain and fog they would not be particularly difficult to hunt at that time of the year, for, from what the natives told me, I do not believe they are nearly as alert as are sheep or ibex. In the fall and winter they spend the entire time in the dwarf bamboos. Like their relatives the goral and serow they like to sleep in the sun on projecting ledges where a rock wall rises at the back, and where in front there is an uninterrupted view over the surrounding country. We

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found many such places with evidence that they had been in use for years.

With his thick heavy body the animal can force his way easily through the dense bamboo thickets and the jungle is interlaced with such trails which appear to be continually travelled. I was amazed at the rapidity with which they can negotiate the roughest country when alarmed.

When in heavy cover the animals will be absolutely motionless until almost kicked out and the natives say that at such times they often turn and charge. I rather doubt this except in cases where they believe themselves to be cornered.

In summer they congregate into herds of 100 or more according to the Chinese, but in the winter they separate into several groups with cows, calves, and bulls together.

The Ta Pai Shan appears to be the extreme edge of their habitat in the Tsingling mountains. The hunters told me that some years there were a good many there but that at other seasons there were very few. This was confirmed by my two hunters who subsequently made their way far back into the mountains and found an abundance of takin.

The five days' trip back to Sianfu was made interesting by an abundance of game. Geese had arrived in thousands, every marsh was alive with snipe and the shooting could be varied with bustards, quail, hares, ducks and pheasants. We were in a sportman's paradise, and within a few hundred

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yards of the main road we could get all the birds we wanted. I had an American goose-call, which amused Collins greatly and which he refused to believe had any merit.

One day while I was sitting placidly atop of a loaded mule, I saw five geese far off to the left. After a few preliminary squawks, I drew such dulcet tones from the call that the birds swung sharp about and headed straight in my direction. I managed to stop the mule but could not climb down from it before the geese arrived. Risking the animal's displeasure, I fired twice, killing one goose dead in the air and badly wounding another. After that, Collins had no more to say.

The day before our arrival at Sianfu, we travelled a road that was a mass of gluelike mud. For ten hours we sat on the loads in the pouring rain, getting off only to shoot a goose or two when we saw a flock not far away. I believe we killed eight or nine within a hundred yards of the caravan. We could not go farther afield, for it was well-nigh impossible to walk at all.

At the west gate of Sianfu we were halted for an hour, although the soldiers admitted that our passports were quite in order. They must telephone the Tuchun, they said, before we could be admitted. It was only one of a thousand petty annoyances to which foreigners are subjected in the Shensi Province. After standing in the cold and wet until our patience was exhausted, we announced our inten-

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tion of going into the city, regardless of officialdom. And in we went.

Three days in Sianfu were few enough, but both of us had so much to do in Peking that we could not linger. A month later our two hunters returned to Peking from Ta Pai Shan with a glorious bag including three takin. Lao Chung attributed their luck to the powers of an old man named Wang.

When I left Lingtai-miao I gave Lao Chung a rifle that had never been used. He said that after several unsuccessful days, when he had wounded animals but could not kill them, Wang told him that without doubt he had failed because the gun had killed a man. No rifle that had killed a man was good for hunting; it would have to be "treated." Wang announced that he would prove to the satisfaction of everyone that the rifle had taken human life. He produced three pieces of bamboo, round on one side, flat on the other, and each perforated with nine holes. If the gun had killed a man, the sticks would always fall with the flat sides up when he threw them into the air. Sure enough they did. The weapon had certainly killed a man. In the "treating" process old Wang traced characters on the barrel with his fingers and then stroked the rifle from muzzle to butt, mumbling incantations. In order to prove that it was now in proper condition for hunting purposes he said he would throw the bamboo sticks again. The first time they would fall with both flat sides up; the second with both round sides and

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the third with one flat and one round side uppermost. The sticks were thrown and fell as predicted. "Then," said Lao Chung, "I went out immediately and killed a wild boar with the first shot. I had no more trouble."

Lao Chung told us also a strange tale about our first takin hunt. He said that the man Liu who had performed a sacrifice at our camp on the Ta Pai Shan, the day we found takin, was one of a few men who had the power to "open" or "close" the mountain. When it had been closed all the game left at once; when it was opened all the animals came back at once.

On this last takin hunt, Lao Chung had had no success until he found Wang, the one who had "treated" his rifle. This old man, like Liu, had the power to open the mountain, and when he had been persuaded by Lao Chung to accompany him on a hunt, he gave a remarkable demonstration of his magic skill. He wrote several characters on three strips of yellow paper, rolled them up and buried them. Then, lighting sticks of incense, he chanted strange words and the mountain was open. Lao Chung never failed to find game when he was with old man Wang. After each hunt the mountain was closed by a similar ceremony. It was useless then for anyone to hunt, because the game all departed to unknown regions. Wang and the few others who had this power were unpopular with their neighbors.

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Lao Chung firmly believed all this. Like most Chinese of the peasant class, he had a simple, superstitious, highly imaginative mind and would tell the most astounding stories in such a way that you could not possibly accuse him of lying. I remember an instance connected with the first takin hunt. After I had killed the cow, I went down the mountain, hunting for wounded animals. While I was gone, Lao Chung suddenly came upon the dead animal and, I presume, was somewhat startled. Immediately his imaginative brain set to work, and by the time I returned he had a story ready. He announced that the takin was wounded, had charged him and chased him up a tree. "But," I said, "I know the wild cow was dead for I killed him myself."

That made not the slightest difference and he stoutly maintained that the animal had not succumbed until after it had treed him.

He has dozens of other wonderful stories which he tells to admiring friends. Neither Jason nor Tartarin de Tarascon could outdo Lao Chung!

CHAPTER IV

UNDER WAY

THE expedition was to leave Peking on April 17, 1922, and for weeks beforehand the headquarters seethed with activity. Every man was occupied with his own individual preparations for the long summer in the desert. The courtyard in front of the laboratory was strewn with skins, boxes and equipment which were being packed to ship to New York or to go with us to Mongolia. Colgate had the main courtyard filled with automobiles and all day the whirr of motors being tested and the ring of hammers made it seem like an open air garage.

As if to bid us Godspeed the lilacs and flowering trees in the courtyard, in full bloom almost a week earlier than in any other part of the city, transformed the compound into a veritable Paradise.

A farewell dinner was given us by Mr. Albert B. Ruddock, First Secretary of the American Legation, at which Mr. C. S. Liu, then Director of Chinese Railroads, became so much interested in our plans that he offered to send the motors and equip-

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ment free of charge to Kalgan and give us two private cars for the staff. His courtesy was doubly appreciated because war-clouds were gathering thickly in North China skies and continual troop movements made railroad transport most uncertain. There seemed to be but little doubt when we left Peking that the expected clash between Chang-Tso-lin, and Wu Pei-fu would take place within a few weeks, as, indeed, it did. We had been provided by the Chinese Ministry of Foreign Affairs with a formidable looking document, which was supposed to permit our cars and equipment to leave Kalgan exempt from duty and customs inspection. When I showed it to Chang Tso-lin's soldiers who were stationed at the road to the Pass, they laughed contemptuously and said, "This is from Peking. We don't recognize Peking." Therefore we had a delay of three days while another *huchao* was being obtained from the military commander at Kalgan.

At six o'clock in the morning on April 21st we left the Anderson Meyer and Company compound in Kalgan, with the three cars and two trucks. Most of our things had been sent to the village of Miao Tan, forty miles from Kalgan, so that the cars might be as light as possible during the rough travel in the Pass. Before we were out of the city gates we were joined by two other motors. One was driven by Mr. Charles L. Coltman, en route for Urga on business. (In December, 1922, Mr. Coltman was shot by Chinese soldiers a short distance out of Kal-

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gan when he was on his way to Urga. He died shortly afterwards in a Peking hospital.) In the other were Mrs. Granger, Mrs. Shackelford and Mrs. Black, who were going to the summit of the Pass to see us safely on our way. I was taking Mrs. Andrews as far as Urga in order that she might get some Paget color plates of the brilliant Mongol costumes. Dr. Davidson Black of the Peking Medical College, who had joined the expedition temporarily in order to obtain data for his anthropological studies, was to return from Urga with Mrs. Andrews.

The seven cars, finally under way, made a very imposing spectacle as they wound up the long river valley leading to the plateau. Coltman, who knew the way better than any of us, was in front, and I drove the next car, carrying Shackelford and his photographic equipment. At every picturesque spot he took a few feet of film, so that our progress was slow, even along the dry-stream bed where the road was fairly good. The Pass itself was reported to be bad and it quite lived up to our expectations. Deep ruts cut by the spike studded wheels of Chinese carts, mud holes, and huge rocks that had rolled down from the hills above, made it an "automobile nightmare." It was the first real test for the cars, and I watched them anxiously. If they negotiated the Pass successfully we would have nothing to fear on the way to Tuerin, for no section of the road is as bad as it is at the Pass and for seventy-five miles beyond Kalgan.

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Wonderful panoramas were unfolded as we climbed higher. When we paused to cool the engines we looked back over a shadow-flecked bad land basin, a chaos of ravines and gullies, to the purple mountains of the Shensi border. Above us loomed a rampart of basalt cliffs crowned with the Great Wall of China which stretched its serpentine length along the broken rim of the plateau. Roaring like the prehistoric monsters, the bones of which we had come to seek, our cars gained the top of the last steep slope and passed through the narrow gateway in the wall.

Before us lay Mongolia, a land of painted deserts dancing in mirage; of limitless grassy plains and nameless snow-capped peaks; of untracked forests and roaring streams! Mongolia, a land of mystery, of paradox and promise! The hills swept away in the far-flung, graceful lines of a panorama so endless that we seemed to have reached the very summit of the earth.

Never could there be a more satisfying entrance to a new country. We stopped only long enough to look about us however, for Berkey and Morris were at once convinced that the geology of the Pass would require a careful study to be properly interpreted. Since the Pass could be easily reached from Kalgan, it was decided to postpone investigation until after our return from Mongolia.

The road that we were to follow wound through cultivated fields, green with winter wheat, passed among brown huts, and lost itself in the mud walls

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of a larger village. At Miao Tan we found our men waiting for us in the courtyard of a Chinese inn, with the gasoline, food and other supplies that had been sent on by cart. For the next hour everyone worked with feverish activity to load the cars so that we might get beyond the brigand infested cultivated area and camp for the night in the grass lands. A great deal of necessary equipment had arrived from New York too late to send by the caravan, and when all the things were piled upon the cars, Colgate and I were horrified. There must have been at least two tons on each of the trucks, which were designed for only half that weight. There was no alternative, for the loads were largely made up of gasoline, photographic supplies, and automobile tires that could not be left behind.

It was four o'clock in the afternoon when we left Miao Tan in a drizzling rain. There was every reason to believe that we would have several days of rain and snow, which would make it impossible for us to travel and do our work. Coltman suggested that we try to reach the Swedish Mission at Hallong Usu. This meant running after dark, but the road was so smooth and hard that, somewhat against my better judgment, I consented to go on. We were not yet out of the region of wheat and oat fields which the Chinese push forward every year into the grass lands of Inner Mongolia.

Mud villages were scattered at infrequent intervals and it is in this area of cultivation that the

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brigands concentrate for attacks upon caravans coming into Kalgan. There is little danger of bandits farther out in the desert for the trails are so few and far between that the traffic is not sufficiently heavy to furnish profitable "pickings" for robber bands. Ever since we had left Miao Tan I had been uneasy because the first day had gone so well. It is almost an inevitable rule in exploration that first days, when men and equipment are untried, are difficult, and I have come to believe that the worse the first day the better the others will be. But before we went to sleep that night we had had trials enough to ensure a wonderfully successful Expedition.

We were driving through the inky blackness of a rainy night and still had twenty-five miles to go to reach Hallong Usu. Coltman, who was ahead, suddenly felt himself on soft ground and a moment later his motor sunk in mud to the running boards. He hurried back in time to warn the rest of us, but in the effort to regain the trail each car became mired. Time after time we left a motor on what seemed to be firm ground, but when the others had been brought up, the first had again sunk so deep that herculean efforts were required to dig it out. It seemed an endless business, but by midnight all the cars were huddled on a bit of high ground which we had discovered, except Coltman's; it was in its original position and was sinking lower. Far in the distance dogs were barking. I sent a man who could speak a little Mongol to bring oxen for Coltman's car. He

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arrived finally with three small animals and a half dozen natives. The bulls were hitched to the automobile but it could not be moved an inch. There was no alternative except to rig the block and tackle, which, as luck would have it, was at the bottom of one of the loads.

Every man in the party was soaked to the skin, covered with mud and shivering with cold; nevertheless there was not a murmur, all accepted the fortune of the road cheerfully and in intervals of chattering teeth, joked about the fact that our first experience at the edge of the Gobi Desert should be one of mud and rain. The sportsmanlike attitude of the men gave me a most encouraging view of the personnel of the expedition.

By means of the huge block and tackle we eventually dragged Coltman's car out of the mud. I decided to camp where we were for fear that worse difficulties might be encountered if we attempted to move to a drier spot. Moreover, it was after one o'clock in the morning and we had eaten only a few sandwiches since breakfast. When I walked away to find the driest spot on which to pitch the tents I was impressed with the fantastic setting of our camp. The roaring cars as they maneuvered for position, the headlights cutting yellow paths through the inky blackness, the barking of dogs and the strange cries of the Mongols who had by this time collected in a crowd about us, gave the scene a touch of unreality that I could still appreciate, wet and tired as I was.

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When the tents were up, Black, Granger, Shackelford and Morris who had not been driving were unanimously elected to stand watch for what remained of the night. Sentinel duty was a necessary precaution because a suspicious looking band of natives heavily armed had ridden past us that morning. They were undoubtedly brigands and, although we were too strong a party to be attacked on the march, there was danger that they might return.

The next morning dawned raw and cold. One by one the men straggled out of their tents to look about. We were on the far edge of a partially dry marsh, but it was almost impossible to figure out how we had managed to get through the mud in the dark. I was glad to see that the men all appeared to be fit and somewhat rested, after the strenuous night. Since no harm had been done I was not entirely sorry that the accident had happened, for it impressed upon all of us the futility of running after dark and gave a splendid example of the behavior of the staff, Chinese and American, under trying conditions. Our cooks produced an excellent breakfast, and by the time the cars were packed and ready to leave at eleven o'clock, the sun was shining brightly.

We were in the grassy hills but Berkey and Morris had more than enough geology to occupy them. From the moment we left Kalgan they had traced a cross-section in which every mile of the structural

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and physiographic features of the country had been recorded. The geologists had a car to themselves with their complete equipment. Our rapid progress made their work extremely difficult and it would have been well-nigh impossible for less experienced men than Berkey and Morris. They had to run off the road continually to inspect whatever rock outcrops showed above the rolling grass lands. They were always miles behind the other cars and every hour we had to stop to let them catch us. After the first few days Morris devoted his chief energies toward the physiography while Berkey recorded the geological changes.

They found that the general structure consists of a vast complex of ancient rocks in which granite predominates; upon these lie basin-like areas of those more modern sediments that often contain fossil bones. Since the Chinese Geological Survey has been investigating this region for some time, we had focussed our attention upon the less known territory of Outer Mongolia.

We camped at five o'clock in the afternoon in a beautiful amphitheatre where the low grass-covered hills rolled away in gentle yellow-green waves from the granite rocks behind the basin. It was a perfect, windless evening—very rare in Mongolia during the spring. Coltman had shot an antelope and a bustard in the morning so we had fresh meat for dinner. The tents went up like magic and in half an hour a tiny city appeared in the grassy valley.

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The early camp gave us time to organize our forces, find necessary items of equipment and eliminate some of the accumulated mud of the previous night. Just as the stars appeared in a cloudless sky we gathered about the *argul* fire and had our first real meal together. Everyone was tired but happy. Long after the fire had become only a glowing heap of ashes we lay on the grass, talking of the interesting months before us in the desert.

Now that we were well away in the grass lands, I promised my companions a glimpse of antelope before the day was ended. They were mildly skeptical about my stories of the sixty-miles-an-hour speed of the animals and I prayed for a herd which would give an exhibition of really high class running. My reputation for veracity was at stake, for can you imagine an animal, not equipped with wings and having no gasoline-tank, which, with only four legs, can go at the rate of sixty miles an hour—a mile a minute?

Not long after breaking camp, we discovered a score of yellow-white forms in the bottom of a broad valley east of the road. Several of us, in the touring-car, bumped down the slope over patches of short, stiff grass, while the other motors continued on their way. At first the gazelles gazed curiously at the car, ran a few feet and stopped to look again. The antelope, wild ass and some other animals invariably try to cross in front of a motor-car, even when, with the wide plain on either side of them, they could

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easily get away. Therefore, I headed diagonally toward the herd, and we were within four hundred yards of them before they finally decided that it was time to take their leave. They ran only half-heartedly, sometimes bounding into the air as if they were on rubber tires, but still we were being left rapidly behind. Shackelford shrieked with delight and implored me to "step on her," even though the car, making thirty miles an hour, bounced over the rough ground like a ship in a choppy sea. Soon the long, yellow line, fatally attracted, bent toward us. Then I shouted to Black and Granger, who were half out of the car, and threw on both brakes. Before it had fully stopped, we had all leaped to the ground and begun firing. The others, new to this kind of work, had no luck, but I dropped an animal before the herd was out of range. We could not drive fast enough over the rough ground really to push the antelopes, but even this poor exhibition of speed sufficed to turn the doubters into my firm supporters.

Of course, gazelles cannot run a mile in a minute. I am sure no living animal can do that. But it is true that, for a short dash, perhaps a quarter of a mile, the Gobi gazelles, when thoroughly frightened, reach the speed of sixty miles an hour. Ordinarily they are curious about the car and will run only fast enough to keep well away from it. But shoot at them a few times and see what happens! Then they all flatten out and skim the ground so lightly that

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their legs become only blurs like the wings of an electric fan.

I do not know how far they can run, but Shackelford and I had an illuminating experience. We found a buck on a hard plain where it seemed possible to run him down and get some reliable data about his endurance. He was loping along easily at thirty-five miles an hour when we cut him out from the herd. We overhauled him rapidly, and he seemed surprised and somewhat hurt that anything really could make him exert himself. So he gave his accelerator a little push and shot up to forty miles. We did likewise. More surprise on the part of the gazelle, and a little more gas on our side. The car was going full out then, and the speedometer registered forty-one miles. The gazelle seemed to think it about time to end matters and, with a burst of speed, crossed in front of us and sprinted away so fast that we could just keep his bobbing white rump-patch in sight. But he soon slowed down, and we chugged steadily on his trail at forty-one miles an hour. The race settled into an endurance test. He kept about two hundred yards in front of us, and so we went for ten miles. Then we got a puncture but he did not. How far the animal could have gone, I would not venture to say.

With our first antelope on the running board of the car, we regained the trail just as the geologists came over the summit of a hill. I told them that

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we would await them for tiffin at Pang-kiang, the first telegraph station, which stands on the southern edge of the Gobi Desert, if the Gobi can properly be said to have an "edge." The grass lands merge so gradually into the arid regions of the Gobi that it is difficult to say just where the real desert begins. However, Pang-kiang on the south and Tuerin on the north delineates it fairly accurately in the region where the Kalgan-Urga trail crosses the Gobi.

"The City of Pang-kiang," as it is often referred to in the Chinese papers, had been the scene of important events since I last visited it in 1919. After the Russians drove the Chinese out of Urga, they carried the war into Inner Mongolia, and for several months Pang-kiang was the first line of Chinese defense. The long hill-slope opposite the telegraph station was pitted with large, horseshoe-shaped depressions, reinforced with cement and arranged in regular lines. These were the "basements" of the quarters in which the Chinese soldiers had lived during the long winter of 1921. Pang-kiang, with its half dozen mud huts, is a desolate place at best, and the ravages of war made it doubly depressing.

All the morning we had been running through pleasant, rolling grass lands, yellow green with the first touches of coming spring. As we neared Pang-kiang, the country gradually changed, the grass was shorter and sparser and Gobi sage-brush was plentiful. But our geologists were agreeably surprised, for they realized that we were coming into a bed-

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rock desert and not one of sand. They reported that for some time we had been passing over sedimentary strata, and, since there were cuts and bad lands depressions, Granger felt that it would be worth while to spend the afternoon in prospecting. Therefore, we camped on the gravel plain above the telegraph station.

Shackelford and Colgate then rigged the wireless outfit for its first trial. We had made arrangements with the American Legation to have the correct time sent out at seven o'clock every evening and to give us any interesting news. The time was particularly important in order that the geologists might check the chronometers that they used in taking latitude and longitude observations. We had purchased the wireless receiving-set in Peking and had considerable doubt as to its efficiency. It looked very business-like when the aerial was erected on tent-poles bound together, but Shackelford and Colgate could not get a sound over the wire. As a matter of fact, the set never did function properly, and, after we left Urga, we were entirely without news, although the legation sent out messages frequently during the five months we were away. Fortunately, the inability to check our chronometers was not serious, for the variation was unbelievably slight: the total error to be distributed over the entire five months was only forty-five seconds. The taxidermists put out a long line of traps for small mammals and for the first time the expedition was really at work.

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The next day, just after leaving Pang-kiang, we stopped at a well beside the trail. Near by is a small temple. On my previous trips to Urga I had always looked forward to this picturesque place, with the curious, good-natured lamas, streaming across the plain on foot and horseback, their red and yellow robes flaming in the sun. I had told Shackelford that he would get some good pictures here, but not a human being was in sight. The white-walled temple, with its gay border of red, and the living-quarters of the lamas were deserted and partially wrecked. Scattered about the plain were dozens of soldiers' uniforms and lamas' robes, some of them containing weathered human bones. Pariah dogs—grim evidence of the fate of the unfortunate dead—slunk in and out of the gaping walls. I suppose it was "Little Hsu's" Chinese soldiers who had destroyed the place but it is certain that few of the harmless priests escaped alive. We left this temple of tragedy with no reluctance and gratefully turned to the sun-drenched plains and the open road.

A little later we had our first meeting with northern Mongols. A great caravan of them, camped beside the road, had just ended the day's march. The camels, crowded together into a compact mass, were still kneeling beside their loads. We seemed to be looking across a veritable forest of curving necks and shaggy bodies, from which the long winter's hair had already begun to fall away in strips and patches. Among them walked the drivers,

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pulling out the pegs that fastened the load-ropes across the back, while the animals grunted and screamed as though they were being tortured. On the outskirts of the caravan some of the Mongols were gathering *argul* (dried dung), the only fuel of the desert, or riding madly back and forth after a flock of fat-tailed sheep, carrying their own flesh and wool to market at Kalgan.

This was the first caravan we had seen. In the peaceful days before the Chinese invasion under "Little Hsu" in 1919 and the subsequent years of war and terror, the Kalgan-Urga trail was a great artery of trade. Dozens of camel caravans and hundreds upon hundreds of ox- and pony-carts continually streamed across the plains; at every well, dome-shaped *yurts* were grouped like giant bee-hives and herds of sheep drifted in snow-white masses along the sides of sheltered valleys. But the two years of war and changing politics have left their mark upon this wild, free land. Trade was paralyzed, *yurts* were gone and the riders of the plains avoided the travelled road. Even the telegraph-line was wrecked beyond Iren Dabasu, or Erlien, as the Chinese call it, which is just within the borders of Inner Mongolia.

We expected to camp at Erlien; for I had instructed my caravan to leave two camel-loads of gasoline at the telegraph office, which is in the basin of a great salt marsh. Just before descending the bluff to the plain, I waited for all the motors to arrive. The geologists had told us that we had been travelling

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over sedimentary strata all afternoon, and to their practised eyes the bluff offered a possible exposure for fossil bones. I decided to go on to the telegraph office five miles away and camp, while they investigated the rim of the basin. Our gasoline was waiting at the station, and the Chinese agent reported that the caravan had passed by two weeks earlier. We then drove over to some promising-looking ridges half a mile to the west and pitched our tents.

While my wife and I were watching a sunset, which splashed the sky with gold and red, the last two cars swung around a brown earth bank and roared into camp. We went out to meet them. I knew something unusual had happened, for no one said a word. Granger's eyes were shining and he was puffing violently at a very odious pipe. So I supposed that the "something" was good news. Silently he dug into his pocket and produced a handful of bone fragments; out of his shirt came a rhinoceros tooth, and the various folds of his upper garments yielded other fossils. Berkey and Morris were loaded in a like manner. Granger held out his hand and said: "Well, Roy, we've done it. The stuff is here. We picked up fifty pounds of bone in an hour."

Then we all laughed and shouted and shook hands and pounded one another on the back and did all the things that men do when they are very happy. No prospector ever examined the washings of a gold-pan with greater interest than we handled the

little heap of fossil bones. Rhinoceroses we were sure of, and there were teeth that could belong only to the titanotheres, a great rhinoceros-like beast that became extinct long before the Age of Man. But no titanotheres had been discovered outside America, with the possible exception of a doubtful fragment from Austria! The other specimens were smaller mammals not positively identifiable, but we discussed and rediscussed the possible origin of every piece of bone. While dinner was being prepared, Granger wandered off along the grey-white outcrop that lay like a recumbent reptile west of camp. Even in the falling light, he discovered a half-dozen fossil bits. We realized that we had a new deposit at our very door.

We were all so eager for the next day's work that sleep came slowly and the camp was astir shortly after daylight. Before breakfast my wife and I walked out to inspect a line of traps that had been set in the sandy mounds of the basin-floor. We had caught an interesting specimen of a new sand rat (*Meriones*), several large hamsters (*Cricetulus*), and a half-dozen kangaroo-rats (*Dipus*); all species new to my collection. While we were busy at the traps, we saw Dr. Berkey with head bent and hands behind his back, wandering about on the ridge near camp. Soon he came in to breakfast with both hands filled with fossils. Granger examined them with a puzzled expression.

"For the life of me," he said, "I cannot make

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that anything but reptile. It might possibly be bird, but it must have been *some* bird to have a leg-bone like that. It certainly isn't mammalian."

It was about two-thirds of one of the lower leg-bones which he held out. It had been found just above camp. A little later, when Dr. Black was walking to his tent, he almost stepped on the missing section, which made the specimen complete. It had obviously weathered out and rolled down from the ridge above. We were confident then that it was reptilian. The geologists, with Granger and Black, went up to the ridge where Dr. Berkey found the bones. Just as my wife and I were starting out on a little shooting-trip, we met Dr. Berkey on his way into camp. "Come up with me," he said; "we've made a discovery, and a very important one."

He would give us no more information until we reached the summit of the outcrop. Then he pointed to Granger, who was on his knees, working at something with a camel's-hair brush. "Take a look at that and see what you make of it," he said.

I saw a great bone beautifully preserved and outlined in the rock. There was no doubt this time; it was reptilian and, moreover, *dinosaur*.

"It means," said Dr. Berkey, "that we are standing on Cretaceous strata of the upper part of the Age of Reptiles—the *first Cretaceous strata, and the first dinosaur ever discovered in Asia north of the Himalaya Mountains.*"

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Unless one is a scientist, it is difficult to appreciate the importance of the discovery. It meant that we had added an entirely new geological period to the knowledge of the continental structure of Central Asia and had opened up a palæontological vista dazzling in its brilliance. With the rhinoceros and titanotherium teeth and the other fragments of fossils that had been found the day before, the dinosaur bone was the first indication that the theory upon which we had organized the expedition might be true; that Asia is the mother of the life of Europe and America.

While Granger was preparing to remove the bone, I returned to camp and asked Shackelford to record the discovery in motion-pictures. Berkey and Morris continued their search and brought a wealth of specimens when they returned for tiffin. It was evident that fossils were abundant along the entire ridge, and the opinion was unanimous that the region must have a much more careful study than could be made in a few days.

The identification of this Cretaceous area and the subsequent determination of the younger Age of Mammals beds which lay upon it and in contiguous regions were not only a personal triumph for Berkey, Morris and Granger, but also for American science. Other geologists had traversed the same formations, but had failed to determine correctly the strata and recognize their vast importance. The splendid achievement of our men was also an

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excellent example of the value of correlated work, which was the principle upon which the expedition was organized. Geology and palæontology are so intimately related that one is incomplete without the other; for the correct determination of geological horizons is largely dependent upon the fossil remains they contain.

The method of finding fossils seems to be a mystery to the layman. As a matter of fact, it is merely a question of scientific knowledge and training. In the first place, geological conditions must be right. Volcanic and metamorphic rocks can never contain fossils; for they have been subjected to heat and chance, which destroy bones instead of preserving them. Thus fossils can occur only in sedimentary strata, such as sandstone, shale and limestone. Fossils are being made today just as they were a million years ago. When an animal dies the skeleton may be covered with sand or other sediments. This heaps up higher and higher and eventually is consolidated into rock. Then a very slow change begins. Cell by cell the animal substance in the bone is replaced by mineral matter and the skeleton becomes petrified, or changed to stone. Sedimentary strata must not be too old—that is, they must not have been laid down before vertebrate animals existed—or naturally they cannot contain the bones of such animals. Not only must a region have the proper age and geological formation for fossils; it must also be opened and cut by ravines and gullies

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or have bluffs and ridges that give a cross-section through its structure.

Long before the Iren Dabasu basin was reached, we had been driving across sedimentary strata, but because they were not dissected there was little possibility of finding fossils. As soon as Berkey, Morris and Granger saw the bluffs which we descended to the salt-lake flood-plain, they realized that here was what they had been seeking—a deeply-exposed cross-section of the rock and sediment on the top of which we had been running for so many miles. From that moment it was simply a question of using their eyes to find bones that had been uncovered by the action of wind and rain.

Contrary to the general impression, a palæontologist seldom digs for fossils unless he sees them. Perhaps it is only the tiniest part of a bone that catches his trained eyes, but it may give the clue to the discovery of an entire skeleton. Perhaps the fossils lie completely exposed upon the surface or have been washed by rain or streams far away from the spot where they were originally buried. Berkey found the first dinosaur bone on the summit of the outcrop above camp. Black found the remaining fragment at the base of the exposure; evidently it had been washed down by a flood of rain, possibly not many days before we arrived. The long ridge beside which our tents were pitched contained bones, teeth and claws of large and small flesh-eating and herbivorous dinosaurs.

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By the slow but resistless action of wind and weather, the hundreds of feet of rock and sediment that formerly lay upon the ridge had been worn away, leaving exposed these strata, deposited several million years ago, near the close of the Age of Reptiles. Farther to the west, toward the bluff from which the ridge takes its origin, the action of weathering has not progressed so far and the cretaceous rock is still overlaid by sediments deposited during the middle Tertiary, the Age of Mammals. After I had gone, the geologists discovered other fossil-bearing beds, far older than those of the bluff and going back to the Dawn period of the Age of Mammals.

At the present time the salt-lake basin is a most God-forsaken region. Spotted by conical, sandy mounds sparsely covered with thorny bushes and Gobi sage-brush—a burning desert under the summer's sun and an arctic desolation in winter—it is very different from its condition six million years ago. The basin was evidently the floor of a great lake or of several lakes and marshes; their margins clothed with a luxuriant vegetation, were the homes of the dinosaurs, turtles and crocodiles, the bones of which we found. The climate was undoubtedly warm and moist, not only here but all over the Central Asian plateau, and the cold winters and extreme aridity of the present day did not prevail until comparatively recent times.

It was difficult to leave this spot where such fas-

cinating glimpses of the long-dead past were being unfolded every day, but I knew that inevitably there would be complications in Urga before permission could be obtained to proceed farther into Outer Mongolia, and that no time was to be lost if the entire expedition was not to be delayed. Leaving Berkey, Granger and Morris, and a taxidermist to carry on zoölogical collecting, I took the rest of the party on the three hundred and fifty mile trip to Tuerin, where we hoped to find our camel caravan.

Long before reaching Tuerin, we could see the ragged mass of granite, which rises like a magnificent citadel nearly one thousand feet above the surrounding plain. We came to the base of the "mountain" just before noon and saw a great caravan camped beside the road. As we drew nearer, I made out the American flag flying from one of the loads and recognized our boxes. It was our own caravan. Merin, the head camel man, said that they had arrived only an hour before. They started from Kalgan, March 21, and we met them April 28. This was the rendezvous! I had told Merin five weeks before to reach Tuerin on this day.

Merin is a remarkable native. He has led caravans for two other exploring expeditions in Mongolia and loves the work. He is honest, resourceful, thoroughly sportsman-like in his willingness to take a chance on anything under the sun, careful of his animals and reliable as a clock. I have a very

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real affection for him. Time after time he has brought his camels to the rendezvous on the appointed day after traversing hundreds of miles of unknown plains. He has carried priceless collections from the very heart of the Gobi Desert without damage to a single box. He never promises more than he can fulfil. Last summer he made a heroic march across four hundred miles of burning desert and arrived with sixteen exhausted camels out of the seventy odd that started. When I told him we had been afraid he could not reach us, he replied: "You need not have worried. I'd have got through somehow even if it was with only one camel. I told you I would come." That expressed his entire philosophy. He had told us he would come and he never thought of such a thing as not arriving.

The caravan was directed to remain where they were while we continued on a few miles to the telegraph station, near which we intended to camp. The line had been wrecked during the recent fighting so that there was no communication north of Iren Dabasu, but we found a good-natured Mongol in charge. He presented me with a letter from Larsen addressed to "Roy Chapman Andrews, Esquire, Anywhere in Mongolia." The letter had been brought to Tuerin by Mr. K. P. Albertson, a very good friend of mine, who had gone to Urga to enter into negotiations for the reconstruction of the telegraph-line. Larsen reported that all was favor-

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able for the expedition, but that I must come to Urga to get passports and attend to other diplomatic matters before we could start west.

The telegraph station is just outside the rocks at Tuerin, and we ran up a narrow, sloping plain to select a camp-site. It would be difficult to imagine a wilder or more rugged spot. The "mountain" itself is the root of an ancient peak, ages ago of majestic height, but reduced by wind and weather to the present chaotic heap of granite. It made an ideal camping-place. When the tents were up, I sent Colgate in one of the cars to get the caravan. Shackelford made his arrangements for the "movies" and at half past three he began singing, "The camels are coming."

My wife and I climbed to a flat-topped ledge, just as the great white leader, bearing the American flag, appeared from behind a boulder at the entrance to the plain. Majestically, in single file, the camels advanced among the rocks and strung out in a seemingly endless line. My blood thrilled at the sight; for it impressed upon me, as nothing else had, that the expedition was an accomplished fact. The camels swung past the tents, broke into three lines like files of soldiers and knelt to have their loads removed; then, with the usual screams and protests, they scrambled to their feet and wandered down the hill-slope to the plain, nibbling at the vegetation as they went.

We had slept and eaten on the ground on the way

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to Tuerin but now obtained folding-tables, chairs and camp-cots, as well as fresh provisions, from the caravan loads, and began to live in luxury. After I had told Liu, our cook, to roast a wild goose for dinner and had arranged for the two taxidermists to set out a hundred traps for small animals, my wife and I climbed over the rocks to a secluded amphitheatre to enjoy the sunset. It was a beautiful evening, warm and without a breath of wind. As we stood in the little basin, looking at the magnificent battlements, which rose tier upon tier above us, she said, "This should be a theatre setting; the scene for some weird tragedy like *Macbeth*." She had scarcely spoken when we heard a subdued roar beyond us to the north. In an instant it was louder, and a yellow cloud rose above the ragged peaks. The air became suddenly colder.

I knew that one of the terrible Mongolian storms was upon us and shouted to my wife to run for camp. We dashed over the rocks and had just rounded a huge boulder when the wind-cloud swept down upon the tents. It came like a cyclone, bringing a swirl of yellow dust and sand. We could not see twenty feet ahead, but we heard a clatter of tins, the sharp rip of cloth, and then a tumbling mass of beds, tables, chairs, bags and pails swept down the hill. Clinging to the great rock, which gave us partial shelter, we watched the yellow cloud pass down the slope and whirl across the plain with the speed of a race-horse. A heavy gale still roared over the rocks

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to the north, but as soon as it was possible to see through the smother of sand, everyone dashed to rescue some favorite article of camp equipment. The Mongols hung to the tents, trying to keep them upright, but cloth was ripping in every one.

The whole side of the cook-tent had been torn away. Poor Liu thought only of his roasting goose. When he saw his little Standard Oil tin oven jammed against a rock and half filled with sand, it was too much even for his Oriental calm.

"*Eya, eya,*" he wailed, "the goose, the goose is spoiled." It was an hour later and pitch-dark before the camp was put to rights. The temperature had dropped thirty degrees, and with that first cold blast winter was back again. It did not leave us finally until June 22.

CHAPTER V

IN THE CITY OF THE LIVING GOD

JUST to the west of the ragged core of rocks where we camped lies the Tuerin monastery. Three temples nestle in a bowl-shaped hollow, surrounded by hundreds upon hundreds of tiny, pill-box dwellings painted red and white. There must be nearly a thousand of them and twice as many lamas. On the north the low hills throw protecting arms around the homes of these half-wild men who have chosen to spend their lives in this lonely desert stronghold.

The day after our arrival in Tuerin, we went to the monastery, so that Shackelford might get some motion-pictures. Before the car had stopped on the rim of the great depression, hundreds of red and yellow lamas poured out from the *yurts* and temples, and we were surrounded and nearly suffocated. The Mongols are likable but they cannot be credited by even their most enthusiastic supporters with the virtue of cleanliness. They do not bathe. They wipe their fingers on their garments and, since their food is largely mutton, they reek with the odor of rancid fat. All this may be

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disillusioning to those who visualize the Tuerin monastery as delicately perfumed with myrrh and frankincense. Nevertheless the dim interior, lighted by the yellow candles and flaming with brilliant streamers hanging from the altar and the walls, made a fascinating picture.

The lamas, fanatics as they are, never can be trusted very far. I have learned from experience that it is wise to be careful in using a motion-picture camera about the temples. Shackelford's camera, with its battery of lenses, is a most formidable-looking object. But "Shack" himself can allay superstitious fears with his winning smile and keen sense of humor, and he wandered about the narrow alleys between the houses of the lamas, into the temples and among the shrines, photographing wherever and whatever he wished and always followed by a laughing mob of priests.

Lamaism, the religion of Mongolia, which was introduced from Tibet, is largely responsible for the present decadence of the Mongol race. The first-born son of every family must enter the priesthood, and sometimes all the boys become lamas. In the temples, where they live, they spend their time in chanting Tibetan prayers, which they do not understand. They are human parasites, mentally and morally degraded, who exist by preying upon the superstitions of the lay population. If it were not that some of them spend only a few months each year in the temples, there would not be enough men

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left at home to carry on the business of living; for at least two-thirds of the male population of Mongolia are lamas.

Although Mongols are among the dirtiest people on earth, their temples are always scrupulously clean. At the far end of the main room is a statue of the Buddha, above an altar bearing ever-lighted candles. Rows of prayer-mats facing the centre are arranged on the floor, and gay streamers of silk hang from the ceilings. The walls are adorned with paintings representing various gods and goddesses—some of them lewd in the extreme. The high priest sits at the right of the altar, with the lamas on the mats below him. The monotonous chanting of throaty voices, interrupted by the clash of cymbals and the throb of drums, makes the service in the dimly lighted room impressive in a barbaric way.

In no country have I ever seen people more fanatically superstitious than the Mongols. They become frenzied at any interference with their religious practices, and yet, like the Chinese, they think they can fool their gods. A missionary told me that one day he found some lamas in a temple, drinking and using the vilest language. When he asked how they dared do and say such things in front of the images, they replied: "Oh, that's all right! We've covered the eyes of the gods with paper, and they can't understand what we say because we are talking Mongolian and not Tibetan."

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A priest is supposed never to take life, but some of the lamas forget their Buddhist principles. In the Altai Mountains I had a lama guide. He had been a hunter, but during a severe illness had given the Buddha his promise to become a lama if he recovered. True to his vow, he shaved his head and went into the temple for a few months each year, but by the end of four years the lure of the mountains had grown so strong that he became once more absorbed in hunting.

Once when my wife and I were camping in a valley north of Urga, the wife of our hunter brought us her baby, which was suffering from eczema. In vain a wandering lama had been exhorting the gods to cure the child. I applied oxide of zinc and sulphur. In two weeks the disease had disappeared. Thereupon the priest collected fifty dollars' worth of sheep and goats from my hunter.

"Do you think it was the lama's prayers or my foreign medicine that cured your baby?" I asked the woman. She readily admitted that it was the ointment.

"Then why do you pay the priest?"

"If I didn't, he would bring a curse upon our family," she replied. "All our sheep and goats would die, and we should have great misfortunes."

Another Mongol at the same village dislocated his shoulder. I slipped the bone in place, and the lama collected two sheep. So it was throughout the summer: I made the cures and the priest got the fees.

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The lamas are supposed to be celibates, but many of them take unto themselves a woman, either temporarily or for life, when they do not live in a temple. The Mongols are unmoral rather than immoral. They are children of nature, with the animal instinct unchecked. The women are careful about exposing their bodies, but do not regard chastity as an especial virtue. Wandering lamas or travellers often demand a woman when they stop at a *yurt* and they are seldom refused. As a result, venereal disease is prevalent.

When we reached camp after visiting the temple at Tuerin, Merin was patching the foot of one of our camels. A most extraordinary operation it was. Ropes were first looped about the legs and, as they were tightened, three men pushed the animal over by main force. Then the hind feet were drawn between the front legs and securely tied. In one of the great flat pads was a small cut. This was sufficient to make the beast lame. Merin first scraped out all the sand and then sewed a piece of thick leather over the wound exactly as one would patch a torn garment. He used a curved needle eight inches long and a rawhide thong. The camel grunted and groaned when his legs were roped and then settled into a continuous wailing. It would have been pathetic had we not known that the groans all came from fright; for the brute was suffering no more pain than does a horse when he is being shod. But under any circumstances a camel will be sure

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to make himself ridiculous; in spite of his colossal bulk he is almost as easily frightened as a mouse.

In the intervals of repacking the caravan loads we explored the innermost recesses of the rocky peaks near camp. Everywhere the heaps of empty rifle-shells, cartridge-clips and discarded clothing gave evidence of battle. In that terrible winter of 1921 several thousand Chinese were encamped near the telegraph station. Baron Ungern sent Cossacks to attack them, but, before the Russians arrived, a Mongol general, by doing miles of hard riding across the plains, reached Tuerin at the head of three hundred soldiers. Without regard for the enormously superior numbers of the Chinese, they attacked at once. The general, whom I met later in Urga, told me about it. "We rode at full speed through the camp," said he, "killing everyone we saw. Then we rode back again. The Chinese ran like sheep and we butchered them by hundreds." Except for the modern weapons, the story might have been a thousand years old; for this method of warfare was a heritage from Genghis Khan: hours of hard riding, regardless of sleep and food, a sudden whirlwind attack and then relentless slaughter.

During the summer of 1922, when the expedition was in the western Gobi Desert, we continually had reports of a great band of brigands operating to the southwest of us. They were under the command of a well-known chief, who had declared war upon all Russians and adherents of the Soviet-controlled

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Mongol government. Any captured Russians—and that phrase really meant white men, since to the Mongols all white men are Russians—were tortured in the most inhuman way. One man was skinned alive. We ourselves did not dare to venture into this region. In the winter of 1922-1923, the bandits were giving so much trouble that the same Mongol general who had operated at Tuerin was sent against them.

I heard the account of the raid from Mr. F. A. Larsen, last spring. There were more than a thousand of the robbers. The general had six hundred soldiers. His methods were direct and characteristic. He halted his men several miles from the bandits' camp and rode in with only six men. They galloped to the door of the chief's *yurt*, dismounted and went inside. Three Mongols were with the chief. "How do you do?" asked the general as he drew his automatic pistol and shot all four men before they could move. Then, going outside, he told the bandits who he was. His name, and their knowledge of the story of a charm which the Living Buddha had given him, frightened them so that they made no attempt to kill him and no resistance when his soldiers came in. He agreed to spare their lives if they would come with him and join the Mongol army. Most of them accepted the terms, but a few refused to go. So with the remark that they had "better make it unanimous," he shot the reluctant ones.

On May 2 we left camp at Tuerin for Urga in one

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car. The city of the Living Buddha had changed in many ways since our visit in 1919. Then, we came as freely as if we were on the open plains; now, the numerous visits to be paid to *yamens*, the endless questioning by agents of the Secret Police, the spying and the searching of baggage made one feel as if one were entering a hostile camp. Nevertheless, Urga had not lost its bizarre charm. Colgate, Black and Shackelford were just as impressed as I hoped they would be when we finally escaped from the outlying examination stations and drove through the Russian section. For two miles the road is distinctly Russian; then it debouches into a large square, which loses its individual character and becomes a mixture of Mongolia, China and Russia. Palisaded compounds, gay with fluttering prayer-flags, ornate Russian houses, felt-covered Mongol *yurts* and Chinese shops are bewilderingly jumbled together.

The day after our arrival I met the Mongolian Minister of Justice, Mr. Badmajapoff, who was to accompany the expedition. He is a grave, handsome man whose charming personality made an immediate appeal to all of us. It was entirely due to the efforts of Mr. Badmajapoff and Mr. Larsen that we were able to satisfy eventually all the government requirements and obtain our passports.

While the diplomatic negotiations were proceeding, we were all busy—Shackelford taking his “movies,” Mrs. Andrews with her color-photographs and

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Dr. Black in the hospital, recording anthropological measurements and observations. We never tired of wandering with our cameras through the narrow alleys of the Mongol quarter, just behind Larsen's house. In front of the tiny native shops were Mongols in a half-dozen different tribal dresses, Tibetan pilgrims, Manchu Tartars, camel-drivers from Turk-
estan and lamas in robes of red and gold. Here one could see all types of head-covering, from the high-peaked hat of yellow and black—through the whole strange gamut—to the helmet with streaming peacock plumes. Inevitably the city had lost its gay, free atmosphere. Those terrible days under Ungern, the "Mad Baron," when the streets were red with blood and the lives of men were of less value than those of sheep, will not soon be forgotten. Nevertheless, Urga remains the most fascinating city I have found in all my wanderings into the strange corners of the world.

One day Mr. Badmajapoff and I drove over the long bridge across the Tola Gol, to one of the palaces of the Living Buddha, which lie at the base of the Bogdo Ola. I had brought a rifle as a present; for the Hutuktu still liked guns although he was blind and old and very feeble. I hoped to be able to see His Holiness, and we waited for a bitterly cold hour in a small building adjoining the palace while my gift was sent in. Hundreds upon hundreds of devout pilgrims were circling the house, prostrating themselves at intervals and gathering

handfuls of sacred dust from the court within the palisades. Even though the Living Buddha had been shorn of his temporal power by recent political events he kept his former glory in the minds of the Mongol people. At last a high lama official came out and courteously said that His Holiness was too ill to receive me but that he appreciated my gift and in return wished to present me with a silk scarf and photographs of himself and his wife. The pictures evidently were taken many years ago.

May 9th had been set for the great festival of the Maidari, which takes place once a year. We were all eager to see it; for it had never been photographed in color or in motion-film. The Maidari, or Coming Buddha, is a most sacred Bodhisattva. A gilded image of him reposes in a splendid temple in Urga. On this day, which is kept in honor of his incarnation, his image is placed on a huge throne, smothered in decorations and drawn about the streets as the central figure in an elaborate procession.

The festival began in the early morning, for the Maidari had a long way to go. At ten o'clock, when we reached the main square, the procession had not yet appeared, but the air was throbbing to the boom of drums and the deep notes of conchshells. As the waves of sound beat down upon us, we could see in the east a great mass of color, advancing slowly. Soon groups could be distinguished; then slender lines and huge umbrellas blazing in the sunlight. Every shade of the spectrum was re-

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peated a hundred times in the gorgeous pageant of marching lamas. As the procession neared us, I recognized the Premier in a robe of spun gold with a priceless sable hat upon his head. Beside him were the four reigning khans, or kings of Mongolia, and behind them a double row of princes, dukes and lesser nobles dressed in dark blue gowns with brilliant cuffs and streaming peacock plumes.

The great throne bearing the Maidari was shaded by a silk umbrella of rainbow colors and surrounded by the highest lamas resplendent in cloth of gold. From the throne silken ropes led off to flanking lines of red and yellow lamas bearing huge umbrellas of bright-hued silk. Behind the Maidari came other lamas, thousands of them, and women dressed in rich gowns with ropes of pearls about their necks and hair ornaments of gold studded with precious stones. Almost ten thousand lamas were with the Maidari, and two or three thousand men, women and children followed. When the procession reached an open square, overlooked by the great temple on the summit of the hill, the throne was halted and the lamas seated themselves upon prayer-mats in converging masses of solid color, with the Premier, the reigning khans and the lesser princes at the very centre and the highest lamas flanking the Maidari.

The seated priests were given tea and food while a red-robed lama in the Maidari's chariot energetically thumped the heads of the populace with a long stick padded at the end. There could not be the

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slightest doubt in the mind of a suppliant that he had been blessed after the ball at the end of the stick landed on his head; for the officiating lama took huge delight in bringing it down with force enough to rock his victim. Nevertheless, thousands of people crowded about the throne and the priest laid on lustily for an hour.

The princesses and wives of the higher nobles made one gasp for breath at their splendor. The wife of one of the great khans in particular was the most magnificently adorned creature I have ever seen. According to the custom of northern Mongol women, she had her hair plaited over a frame into two enormous flat braids, curved like the horns of a mountain-sheep and reinforced with bars of gold. Each horn ended in a gold plaque, studded with precious stones, and supporting a pendant braid like a riding-quirt; this was enclosed in a long cylinder of gold, heavily jeweled. On her head, between the horns, the lady wore a gold filigree cap studded with rubies, emeralds and turquoises, and surmounting this, a "saucer" hat of black and yellow, richly trimmed with sable. Just above her ears great ropes of pearls hung from her gold cap half-way to her waist. Her skirt and jacket were of rich silk; over all was thrown a dazzling brocade coat with prominent puffs upon the shoulders.

The princesses had a dignity that was very becoming to their high estate. They were accorded none of their husbands' privileges, so far as the procession

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was concerned, but, each accompanied by a servant, they moved majestically in the midst of the vast crowd. Now and then they stopped to talk quietly for a moment with a friend or to acknowledge the deep salutes from both men and women by a slight bend of the head and just the ghost of a smile.

On the day following the festival, my wife and Dr. Black left Urga for the return trip to Kalgan. They rode in a large car driven by Mr. Brandauer, and his own motor, with a German chauffeur, carried a party of Chinese. Two days later, early in the morning, I had a letter from my wife saying that Brandauer's car had had a serious accident. One Chinese had been killed and among the injured was an old Mongol whom I was sending down to guide my caravan to the rendezvous outside Urga. His skull had been fractured and his collar-bone broken.

At the same time news filtered into Urga that a great battle had been fought between Chang Tso-lin and Wu Pei-fu and that Chang had been defeated. It was most depressing to know that the return trip had begun so unfortunately for Black and my wife and that they would probably run into a full-fledged war in the vicinity of Peking. It would be impossible for me to know for months whether they had returned home safely.

At last Larsen and I were asked to meet the Mongolian Cabinet at the Foreign Office, where the final details of the Expedition permits were to be discussed. The Premier, the Minister of Foreign

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Affairs and many other officials were arranged in solemn conclave about the table. I was presented with a contract in which the Expedition pledged itself to do certain things and to refrain from doing others. After the conditions had been somewhat modified, the Foreign Minister and I signed the agreement.

Then the Premier asked that, if it were possible, I should capture for the Mongolian government a specimen of the *allergorhai-horhai*. I doubt whether any of my scientific readers can identify this animal. I could, because I had heard of it often. None of those present ever had seen the creature, but they all firmly believed in its existence and described it minutely. It is shaped like a sausage about two feet long, has no head nor legs and is so poisonous that merely to touch it means instant death. It lives in the most desolate parts of the Gobi Desert, whither we were going. To the Mongols it seems to be what the dragon is to the Chinese. The Premier said that, although he had never seen it himself, he knew a man who had and had lived to tell the tale. Then a Cabinet Minister stated that "the cousin of his late wife's sister" had also seen it. I promised to produce the *allergorhai-horhai* if we chanced to cross its path, and explained how it could be seized by means of long steel collecting forceps; moreover, I could wear dark glasses, so that the disastrous effects of even looking at so poisonous a creature would be neutralized. The meeting adjourned with the best of feeling; for we had a common interest in

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capturing the *allergorhai-horhai*. I was especially happy because now the doors of Outer Mongolia were open to the expedition.

At Larsen's house we found the old Mongol who had been injured in the motor accident on the way to Tuerin. He brought from Colgate a note that gave me great satisfaction. Colgate said that the plucky old fellow had made light of his wounds, although he was painfully smashed up, and had insisted on fulfilling his duty of guiding the motors to the appointed rendezvous nineteen miles west of Urga. They had arrived several days before and all was well with the party.

Nothing ever looked better to me, when we arrived two days later, than did the blue tents of our camp pitched on the side of a gentle slope with a great snow-bank glistening in the distance. Beyond was a small temple surrounded by a half-dozen Mongol *yurts*; the place rejoiced in the name of Bolkuk Gol.

Not more than two hours after we reached camp, Merin came galloping in on his great white camel. He reported that the caravan was only half a mile away and that all the animals were in good condition. Soon we saw the long line of camels silhouetted on the summit of a hill with the American flag streaming above the leader. Thus for the first time the entire expedition was together. It was another instance of the remarkably close connection maintained throughout the summer between the caravan and the motors.

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We should not see the camels again until we reached Tsetsenwan's, a hundred and sixty miles away. So I worked until long after sunset, taking food, gasoline and other equipment from the camel-loads and putting in instead all the specimens that thus far had been collected. We celebrated our reunion with a huge dinner, and I went to sleep with peace and thanksgiving in my heart. The last barrier had been passed and before us lay an open trail to the Great Unknown.

Before we left I had the disagreeable duty of sending back to Urga a French mechanic who had come with us from Kalgan. I had engaged him because he knew cars and spoke the three most useful languages, Mongol, Russian and Chinese.

He was one of those men who have succumbed to the fascination of Mongolia—a fascination as elusive as it is potent. I have known men to whom the country was forbidden under sentence of death, yet they seemed powerless to resist its spell. Our mechanic had been living in Peking for several years, he said, but the ambition of his life was to return to the plains and deserts of Mongolia. The land of freedom and great spaces! The land of opportunities! He was barely five feet tall, but he swelled with emotion as he spoke the words.

Just before we left for Kalgan, he asked if he might take strychnine and other drugs to sell to the Mongols. Of course I refused; for the expedition could not be connected with trade in any way, and,

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particularly, not with drugs. He accepted the decision philosophically enough, and I dismissed the matter from my mind.

He drove the geologists' car, and before many days Berkey and Morris obtained some illuminating glimpses of his diminutive soul. He volunteered the information that he was an anarchist; he hated governments of any kind and he liked Mongolia because every man there was a law unto himself. Apparently he hated life in general; the sight of a skylark pouring forth its very heart in song drew forth a shot from his pistol or a stone when his cartridges were exhausted. He kept a candle burning in his tent all night, saying that the darkness depressed his spirit and filled his mind with "black thoughts." The slow progress of the geologists in their scientific work drove him mad. One day he said to Granger: "Rocks, rocks, there are plenty of rocks ahead; too many rocks, and yet they will not go! See, in one hour we travel only five miles!"

"Never mind!" said Granger. "The next hour, we'll probably make only three!"

All this I did not know until I obtained our passports from the Mongol government. When I gave the small anarchist's name as a member of our party, startled looks passed between the Minister of Foreign Affairs and the Soviet Adviser. They spoke quickly in Mongolian, and the Russian left. I heard later than he had gone to despatch a telegram to Moscow. I was not long in learning our man's

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record in Urga. He was reported to have been a member of a band of brigands in the west, which robbed Whites and Reds alike during the bloody days of Baron Ungern. He was a camp-follower, subsisting on the spoils of robber-bands, a human jackal. The Soviets wanted him badly, although they did not tell me so. Of course, I decided to send him back at once and I obtained a Chinese chauffeur to fill his place.

When I told our anarchist that he must return, he became as pale as wax. "They will hang me if I go to Urga," he pleaded. "You'll have my blood on your hands. It is death for me to go there."

"Why did you come to Mongolia with such a record?" I asked. "You knew you would be killed."

"I don't know. I had to come back. The plains called me. I thought the American flag would protect me!" he whimpered.

Perhaps I might have been affected by his terror had I not discovered a thousand bottles of strychnine in his bed-roll. He intended to sell it to the Mongols for use in poisoning fur-bearing animals. That was the finishing touch; for it would have meant the ruin of the expedition to bring this contraband into the country. I had made strong statements to the Mongol officials regarding the purely scientific character of the work, and they had exempted our caravan from customs inspection. There was only one thing to do: to send the man with his strychnine into Urga under escort, accompanied by a statement of

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the case to the Minister of Foreign Affairs. I learned subsequently that he escaped from Urga just one day ahead of the hangman. Like others whose stories I could tell, he still lives in Kalgan at the entrance to Mongolia, not daring to cross the frontier, but unable to tear himself away.

I know a dozen men who, during the bloody days of "Little Hsu," "Mad Baron" Ungern and the Bolshevik advance guard, saw women and children butchered in the streets of Urga, or swinging by the neck from their own door-posts, and dogs gnawing at frozen bodies in every alley; men who themselves have passed through tragedies enough to shake the strongest nerves; men who have seen their business ruined by war and changing policies and yet have returned to Mongolia at the first indication of comparative peace. If you ask them why, they answer: "I don't know. I like it. I believe in the country." They never have phrased to themselves the fact that they have the frontiersman's spirit—the same spirit that won our American West, that won Alaska and that will continue to win the wasted places of the earth until all have been reclaimed. Such men feel the lure of the mountain and the desert, of the vast open and of the limitless sky. The wild, free life calls to their primitive human instincts; life in the raw, stripped of artificial conventions, where strength, endurance and courage are the ultimate test, where the last resource is the Man Himself.

CHAPTER VI

TENTING IN LAMA LAND

WHEN I awoke in camp at Bolkuk Gol on the morning of May 19, I was filled with delightful excitement. At the end of the day's run we were in a new region.

Climbing a long slope to the ridge of a low mountain-chain we passed through a rocky gateway and came into a country of rolling grass lands. From the summit of almost every hill we could see groups of grazing antelopes and sometimes herds of several hundred. Marmots popped in and out of their borrows like toy animals manipulated by strings, and once two wolves loped across the trail in front of us.

Twenty-five miles from Bolkuk Gol we found a well in the bottom of a beautiful valley and decided to stop. Although we were still in pre-Cambrian igneous rocks, which, because of their age and formation, could not contain fossils, Berkey and Morris needed some time to study the complicated geology of the region. The tents were pitched in the centre of a great amphitheatre formed by rounded, grass

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covered hills, which gave partial shelter from the wind. We spent two days there. Granger and I set a long line of traps, which yielded an interesting variety of small mammals—hamsters, field-voles, gophers, conies and kangaroo-rats, of species not in my collection. Colgate, Larsen and Badmajapoff went after antelopes and brought in five. Berkey and Morris worked like mad in the daytime, running nearly a hundred miles over the surrounding country, and sat up half the night, "shooting the stars" for our geographical position. Shackelford hunted marmots and kept the taxidermists supplied with specimens.

In the northern grass lands and on the slopes of the Altai the marmots gave us never-ending amusement. They are first cousins to our American woodchucks and are reported to be responsible for the spread of pneumonic plague. They are fur-bearers of commercial value: millions of skins are shipped to China and Russia every year and distributed to all parts of the world. The autumn fur is gray-brown, soft and very thick. When the animals emerge in the spring after their months of hibernation, they have changed their garments for a dress of bright yellow, which is most conspicuous in the green grass of the plains.

Though marmots can easily be trapped, the Mongols always shoot them. Their curiosity and their dislike of dogs are often utilized against them by the hunter. One day I saw an old Mongol, with a

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flintlock on his back and a dog's skin thrown across his saddle, riding toward a marmot colony. He hobbled his horse, perhaps three hundred yards away, and got down on all fours with the skin arranged on his back. He advanced toward the nearest marmot, now and then stopping to bark.

The little animal stood on his hind legs, whistling excitedly, and then ran to the mound of dirt near his hole, which he mounted for a better view. The Mongol approached closer and closer, barking hoarsely. Then suddenly he flattened himself on the ground and pushed his old flintlock forward into position. The marmot seemed on the verge of exploding. Standing on tiptoe on the very summit of his mound, whistling and chuckling, he tried to see what had become of the "dog." His fat little body silhouetted against the sky offered a first-rate target. The Mongol fired, leaped forward and seized the animal before it wriggled into the hole in its death-struggle.

The native's more usual method of hunting is to chase a marmot into its hole and then dispose himself at full length fifteen or twenty feet away with his gun in position. Sometimes he waits for an hour before the marmot pokes his head out of the burrow; sometimes for only a few moments. But hours or minutes are all one to a Mongol. He is perfectly happy to lie there in the sun, himself half-asleep, and await developments. I have heard from both white men and natives of the dance that the

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marmots sometimes perform, but I never have seen it myself.

When the geologists reported that they had solved the structural problems that puzzled them, we went on to Tsetsenwan's, driving over beautiful grass-covered hills and into valleys fresh with streams of sweet, clear water. But there were so few inhabitants along the trail that it was surprising suddenly to top a long slope and see below us, at the base of a rounded hill, the monastery, like a miniature city of tiny houses, temples and pinnacled shrines, walled in by enormous piles of *argul*. Before the lamas had time to give more than a yell of surprise, we roared past the temple and sped on to our camping-place. It was two miles beyond, in the mouth of a deep canyon completely sheltered from the wind.

It was necessary for us to wait at Tsetsenwan's for our caravan, although, from the palæontological point of view, the region was disappointing. It continued to consist of metamorphic and igneous rocks of very great age. Berkey, Morris and Granger came to the conclusion that, since we were travelling parallel with the outcrop of strata, we should find no sedimentary basins until we turned sharply southward. Nevertheless, they considered the country geologically interesting and they were busy every moment.

On the ridges and hill-slopes near camp were many ancient remains of great archaeological interest. In fact, the whole countryside was dotted with them. They were of two kinds: one, a large circle of small

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stones with a rock mound in the centre; the other, a rectangular space enclosed by upright granite slabs. The former were probably tribal meeting-places or monuments of a ceremonial type, and the latter were doubtless graves. The natives could tell us nothing about them except that they were very old and had been made by people who had lived long before the Mongols came. Badmajapoff said that in the country to the west, members of the Kozloff Expedition had opened many similar graves, which contained skeletons, together with iron and bronze objects. Douglas Carruthers in his *Unknown Mongolia* has discussed remains from the grass lands west by north of Tsetsenwan's and has published photographs of ruins almost exactly like those we found. These he calls "tumuli," or "*kurgans*"; i.e. "strangers' graves." He concludes that southern Siberia and the territory west of the place where we were camping must have been very favorable for the rise of early races. Certainly the numbers of tumuli indicate that this was a populous region. Berkey and Morris discovered between two lakes to the north of our camp a well-preserved and very ancient dam, a half-mile long by fifteen feet high. I hope to be able some day, with the help of an archaeological staff, to explore the tumuli in this locality; for study of them will undoubtedly shed light on the history of the pre-Mongol people.

When we left Tsetsenwan's for Sain Noin Khan's residence, one hundred and fifty miles away, we

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continued westward on a trail so faint that sometimes it was lost entirely. Yet this path goes for hundreds of miles from Urga to Uliassutai and has kept its identity through untold ages. The geologists were well-nigh in despair; for they found so complicated a series of very old rocks, much folded and crushed, that they had great difficulty in carrying on their structural and topographical route-map.

Amid crashing thunder, vivid lightning and a deluge of rain and hail, we arrived at Sain Noin Khan's and pitched our tents in a little gulch tributary to the main valley and four or five miles distant from the lamasery and the palace of the reigning Khan. Coming to the summit of a long, grass-covered hill, suddenly we saw the golden spires and upturned gables of the temples glistening in rainbow colors on the green plain below us. Just beyond, the river has cut its way through a table-land of solid rock and in the distance rises wave upon wave of mountains white with snow. The temples are in the centre of the "city," with the tiny wooden houses of the lamas spread out on each side like great wings. More than a thousand priests live in that lovely spot. The central temple has the squat base common to Tibetan architecture, but upon it is a typically Chinese pagoda-like superstructure. Immediately behind stands a large Tibetan building, rectangular and flat-topped, decorated in black, white and red. There are ten temples in the city, mostly Tibetan, but some pure Chinese and still others combining

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the two styles. Among the dozens of objects of religious interest in the open space in the centre of the "city" is a large shrine plated on the sides with Standard Oil tins and topped by a cupola heavily covered with gold-leaf. Tiny flags bearing sacred mottoes flutter from every compound, and near all the temples are prayer-wheels. On a hill in front of the temples is the largest *obo* I have ever seen. It is an enormous circular base of stones with a secondary tier and a conical centre, which is decorated with prayer-flags, bits of cloth and branches. This kind of religious monument is very common in Mongolia; in fact, almost every high point of land or hilltop, particularly if it be on a trail or road, has its own *obo*, which grows as each traveller who has reached the summit adds a stone or two.

The Khan's winter palace is in the northeast corner of the lama city and, with his private temple, is surrounded by high palisades. When the Khan is in residence, very probably he occupies a *yurt* in the palace grounds; for a Mongol, however exalted be his station, never can be really comfortable except in his felt home.

The *yurt* looks like an enormous beehive, and, being circular, has no flat surfaces to resist the wind. It can be erected in thirty minutes; in the same time it can be taken down and packed upon a camel. Felt is so excellent a non-conductor that in the winter when a fire is lighted in a sheet-iron stove or in the open brazier, the *yurt* is warm even though the

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temperature drops to forty degrees below zero. In the summer, when the side-coverings are rolled up, the wind has a clear sweep through the house, and on the hottest days the interior is delightfully cool.

I sat one day in the *yurt* of a Mongol prince. In the place of honor, at the far end opposite the door, was a low dais. At the right stood a carved wood chest for clothes and personal effects; at the left was the altar, with a Buddhist painting before which two candles were burning. The floor was carpeted with skins of sheep and wolves. I noticed that the tips of the slender poles forming the pavilion roof were shaped like spear-points.

"Why do you make the roof-poles like that?" I asked the prince.

He considered for a moment. "I don't know why. My ancestors always have done it so," he remarked finally.

"Isn't it because your ancestors, who were great warriors, always carried spears and shields? And at night, when a man was on a raid, would he not stick the base of his lance into the ground with the point against his shield and then throw a skin over the framework to give him shelter? I think your *yurt* is only an imitation of that old custom."

"Probably that is true," he said, but he was not interested in the idea; for a Mongol does not inquire into the cause of things. He is content to do what always has been done and let the reasons take care of themselves.

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At the time of our visit, the Khan, who is only ten years old, was living a long way to the east of the city, and we did not see him. His uncle, a high lama, was at the hot spring fifteen miles from our camp. Badmajapoff, who has suffered from rheumatism since 1920, when he was tortured by Chinese soldiers in Urga, went to this spring for the baths while we shifted camp to the north.

The tents were pitched in a beautiful patch of woodland over a mile in length, near the Arctic divide. It was like a drink of cold water to a thirsty man to see trees again. There was not a breath of wind, the sun lay warm and bright in the forest glades and the air was sweet with perfume from the larch-trees. A gorgeous carpet of flowers, orange, blue, yellow and purple, was spread over the hillside. Every evening we gathered about a great fire of logs and talked until far into the night. We felt that we should like to remain there always. But one morning Merin rode up the hill with the news that the caravan was at the hot spring, where Badmajapoff awaited us. We had no longer any excuse for staying; we must leave this paradise of trees and flowers to travel southward to the wastes of the Gobi Desert.

We arrived at the hot spring, which was only forty-five miles away, early in the afternoon. Badmajapoff had information that filled us with enthusiasm. The Mongols reported that a little more than a hundred miles to the south, just in the region

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where we had planned to go, there were fossil-beds—bones, they said, as large as a man's body. Their description sounded like that of a great sedimentary basin.

As soon as camp was made, Granger and I went to the hot spring for a bath. The water bubbles out from the base of a hill and spreads over a rocky slope in a dozen streamlets. At various spots pools have been constructed in the rock and each is covered by a tent. The water is crystal clear with only a tinge of sulphur but it has a decided odor. A cold stream that emerges from the hill-slope near the hot spring has been cleverly directed so that each pool has a continual flow of both hot and cold water. The pool nearest the source of the hot water was reserved for the lama Prince and above it a spacious *yurt* had been erected for his use.

Just above the spot where the spring emerges from the hillside there is an *obo* in the form of a semi-circular rampart. In the centre is a stone altar bearing three flat, upright slabs upon which pictures of the Buddha have been erected. Scores of silken scarfs, faded and whipped to ribbons by the wind, drape the altar; these are the offerings of pilgrims who have come to bathe in the water and to drink it. There are new scarfs, too, blue as the sky above the shrine. The Prince told us that this was a very sacred place and that we must not step inside the sanctum. It was built, he said, as a thank-offering to the Buddha, for the water which he had caused

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to rush forth from the hillside, hot and pregnant with the power of divine healing. We were not surprised at this worship of the spring. Imagine a caravan in the bitter days of winter, when the wind cuts like a white-hot brand, winding over the hills and pitching its tents on the plain beside the stream. When the loads have been lifted from the tired camels, the frost-bitten nomads walk across the valley to find this spring that offers warmth and comfort gushing from the frozen earth. What wonder that the mountain behind it has been made a holy spot where man may take no form of life.

Below the stream and at one side lay a confused mass of stones. At first they appeared to have been washed there by a sudden cloud-burst, and yet the heaviest fragments gave evidence of a once orderly arrangement. Moreover, some of them were foreign to the mountain at the base of which they rested. In the dim past a massive shrine or a temple must have stood upon this spot. Certain it is that the mountain and the spring have been sacred since before the days of the Mongol Empire.

The Prince showed us, with the greatest care, a dull-brown viper coiled beneath a rock fragment at the base of the altar. Had it been found across the stream, it would have been crushed to death, for the Mongols know the deadly poison in its fangs; here it was jealously protected because it had selected this sacred spot as its home. Even the bath-tents and the *yurts* below the stream are often invaded by

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reptiles of this kind. Badmajapoff told me that two had paid him a visit the day before. He has a deadly fear of snakes, but he had gently persuaded these to go outside.

The Prince is one of the few lamas I have met whose acceptance of their religion seems deeply emotional rather than merely superstitious. He is a small man with delicate, tapering fingers, fine features and a skin almost white. Although he was cordial, always, I think I never saw him smile. His rather sad face has a singular gentleness of expression and his carriage and every motion are full of dignity. When seated, he unconsciously assumes a Buddha-like attitude that emphasizes the teachings of a religion in which contemplation and mental composure are vital tenets. He does not smoke; neither does he drink wine. He has a naturally scientific mind. He was delighted with Shackelford's carbide lamp and, when some of the grey "pebbles" were dropped into a cup of water and a lighted match was applied to the liquid, he quite understood the principle of acetylene illumination. When Berkey and Morris paid their farewell visit to him, Morris asked permission to sketch him in his *yurt*. After selecting the books and ceremonial objects that were to be in the picture, he assumed his characteristic Buddha-like pose and sat motionless, only interrupting now and then to pound the little drum that brought members of his suite to see how the drawing progressed.

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The time we spent at the hot spring was "moving-week" with the Mongols. Dozens of villages were being shifted to the hills and mountains for the summer's grazing. In the autumn the people would go back again to the plains and the desert to escape the snow. All Mongolia seemed to be in motion. One morning when we looked out of our tents, the valley as far as we could see was alive with sheep, ponies and camels moving northward. By noon the sunlit slopes were deserted, but before nightfall other herds had arrived and white *yurts* dotted all the landscape. We had but to remain where we were to watch the pageant of Mongol life pass before us. It was wonderful material for Shackelford.

On the day we left the hot spring, he made an excellent film of the erection of a *yurt*. A Mongol with his wife and an old lama had just halted their camels on a beautiful, grassy hill. First the lattice framework of the *yurt* was opened, and all the household goods, including a baby in a basket, were moved inside. With a long pole the woman held up the circular piece at the top while her husband inserted stick after stick in the framework, to form the cone-shaped roof. Then, after the door was put in, the side layers of felt were tied in place and the felt strips on the roof roped down. The *yurt* was completely erected in a half-hour.

I was impressed by the similarity between some of the customs of the Mongols and those of the plainsmen of our own West in the early days. Hos-

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pitality is a law in Mongolia. If a traveller is near a Mongol village at night, he unsaddles his pony, turns it out to graze and goes into the nearest *yurt*, certain of food and shelter. Compensation is not considered; for every man will find himself often in like circumstances. One summer when one of our Mongols was out for nearly a month in search of our caravan, he spent only thirty cents for food during all that time. I have known a Mongol to ride many miles to let me know that there was no water in the direction in which I was going or to bring in my horses, which had strayed during the night. He would have expected like courtesy from me under similar circumstances.

Horse-stealing is the worst crime a Mongol can commit, and a thief is shot on sight. If a man could not turn out his ponies to graze without fear of theft, travelling would be well-nigh impossible; for to be left without a horse in a country of vast distances and little water is very serious. If a Mongol reports that his ponies have been stolen, soldiers take up the trail and follow it from one herd to another until they find their man, even though they may spend weeks in running him down.

Existence in Mongolia is not easy. A man cannot obtain food enough in a day to maintain himself for a week as in the forested tropics. If he is to survive, he must be able to ride and shoot and to endure fatigue and hunger, cold and thirst. It was such hardihood that made the Mongol hordes the terror

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of all Europe in the days of Genghis Khan. The soldiers of the great chieftain could travel without a commissary, live upon dried mare's milk and, if there was nothing, tighten their belts and laugh at hunger. Riding for hours without rest, sleeping beneath the stars or in the snow, striking lightning-like blows at their enemies, Mongol raiders were here today and gone tomorrow. It was not until the poison of luxury gained from conquered western peoples had begun to sap their strength that they in turn were conquered.

Berkey and Morris mapped geographically and topographically about thirty square miles of country around the Hot Springs. They worked with feverish energy; for I was anxious to reach the fossil-beds reported to be to the southwest. I had despatched the caravan the day after our arrival at the hot spring and we expected to find it at a small river some fifty miles from the fossil locality.

All along the trail, which led up and down grassy slopes, the Mongols were on their way to the sweet grass of the hills, and great herds of antelopes were working slowly northward from the desert whither we were going. After running west for fifteen or twenty miles, we turned sharply south across country. Very soon the landscape began to change. The grass was thinner and grew in clumps, and rocky outcrops appeared. From the summit of a hill we made out presently with field-glasses the blue tent of our caravan, and then we descended into desert

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country. The centre of the basin was occupied by a salt lake and an enormous field of niggerheads; to the west were wild, ragged peaks of granite, which in the haze of the late afternoon showed dim and ghostly against the sky; beneath our feet lay fine gravel, studded with clumps of sage-brush and bunches of long grass as stiff and hard as wire. Merin had said that here the camels would find particularly good grazing. There is no accounting for a camel. In bodily form he seems to be a relic of prehistoric times, a survival from the Pleistocene, and he has tastes as peculiar as his appearance. In the midst of green grass he languishes and grows thin, but surrounded by sage-brush and thorny vegetation he is thoroughly happy.

The desert swarmed with life. The traps yielded such a great variety of new mammals that the three taxidermists were busily preparing specimens every moment. The lake was full of breeding wild-fowl, and lizards of three species scuttled across the ground at almost every step. In the forests from which we had come, where conditions seemed especially favorable for an abundance of life, it was difficult to catch more than three or four small mammals in a hundred traps, and the woods were silent except for the notes of a cuckoo or the discordant call of a jay. I have often found it so and have come to look upon the Asian deserts, and not the forests, as the real collector's paradise.

The Sair Usu trail from Kalgan to Uliassutai was

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only a hundred yards from our camp. One beautiful, windless evening, just as day was giving place to night, we heard the mellow notes of camel bells and saw the black mass of an enormous caravan against the sky. Silently, except for the bells, the great beasts came out of the dusk and disappeared into the twilight glow of the western sky. We all gathered at the trail, hoping for news of China, and two of the men stopped to talk. They were Mahomedan merchants, they said, bound for Uliassutai with tea and tobacco. Five months later they would return with skins and wool. It was already ninety days since they had left Kalgan—sixteen men with two hundred camels. All their wordly goods were involved in this venture, which calls for transcendent business courage. Yet they were but following the custom of their ancestors, who had traced the great trade routes across the desert long before the travels of Marco Polo.

With the passing of that silent line of camels in the darkness I realized more fully than ever before that Central Asia still lives in the Middle Ages and that the caravan trails serve the same purpose today as they did ten centuries ago. But their years are numbered. We ourselves are the "trail-breakers" of motor transportation and after that will come the railroads. Instead of thrilling with pride at the thought, I reflected sadly that we were violating the sanctity of the desert and destroying the mystery of Mongolia.

CHAPTER VII

A KENTUCKY DERBY IN THE GOBI DESERT

THE Altai, the greatest mountain system of Central Asia, extends east by south into the Gobi Desert. As it reaches toward the rising sun, it becomes lower and less rugged and breaks up into partially isolated ranges and spurs, which gradually lose their identity and are merged in the rolling desert. The fossil-bearing region that we were seeking was said to lie just to the north of Baga Bogdo, one of the mountain groups of the eastern Altai. There were no trails, and the chance of being able to reach Baga Bogdo in our cars looked far from promising. But Merin reported the feed to be so good that I decided to leave the weary, sore-backed camels to revel in the sage-brush and thorns while we attempted the journey by motor.

Bayard Colgate and Badmajapoff spent a day on a fruitless hunt for a certain rich man, supposed to live fifteen or twenty miles away. From him they expected to get information and a guide to Baga Bogdo. But they found only a village of six *yurts*

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and were directed to the poorest man in the whole region. His *yurt* consisted of a few pieces of felt thrown together, and his earthly possessions totaled one wife, one horse, one sheep and one goat.

Taking enough food, gasoline and other supplies to last a fortnight, on Wednesday, June 21, we set out with our Mongol guide sitting proudly on one of the trucks. He had never seen an automobile before, but he was prepared to find life a series of delightful surprises and to "try everything once."

Just before noon a great shining lake appeared in the distance. Upon reaching the shore, we found not a salt lake, but a lake of salt. Near the eastern end were six camels and four Mongols. They had a dozen or more piles of beautiful salt, as clean and snow-white as if refined for table use, drying in the sun, and full sacks ready to be loaded on the camels. From the manner of crystallization Morris pronounced it practically pure sodium chloride. The entire surface of the lake consisted of a solid salt crust, more than an inch in thickness, which rested on mud.

As we looked over the country to the south, Colgate and I wondered how on earth it would be possible to cross it with the motors. It makes me shudder even to write about the places through which we took the cars and trucks during the next four hours. There were ravines, ditches, walls, rocks and washouts. Only Colgate's good driving and resourcefulness got us through without a disastrous

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smash. The Dodge Bros. cars climbed like mountain goats, and later, in our enthusiasm, Colgate and I agreed that we should be willing to attempt the ascent of Mount Everest with them if the snow could be eliminated.

Once over the mountain-range, we were immediately confronted with a river of sand. This was a bit too much. Shackelford and I scouted up and down the bank but found no way around; we just had to pass that river or stay where we were. At last we decided to try it with one of the trucks. Roaring and snorting like an angry beast, the big fellow went down the bank, plowed through the sand and up the other side without even hesitating. The others followed its broad trail and in five minutes the entire fleet was safely across.

At a near-by well there were Mongols who said that they had come from the desert to the south. That morning, when they went to get their ponies, they found with them a herd of wild asses. That was good news; for I was anxious to get a group of wild asses for the Hall of Asiatic Life in the American Museum. Wild asses are found only in Asia and Africa. The Mongolian species was but imperfectly known, and no museums in America possessed specimens of it. Long ago Larsen and I devised a plan for roping wild asses and bringing them back to New York alive. We thought now that, if the ground was hard enough for the car to run at high speed, we should be able to put our scheme to the

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test. At any rate we wanted skins and motion-picture film; for the animals had never been photographed in the wild state.

The following day the geologists, with Granger, Colgate, Larsen and the guide, took a car down the valley to visit the spot in which the Mongols had said there were fossils. At half past seven in the evening the exploring party returned. They reported a very difficult trip, but that the way was not impossible for the cars. In a three-hour search a few bone fragments had been discovered which, although they were not very impressive were sufficient to show that it was fossil-bearing terrain. Through the glasses, moreover, Granger had seen a wild ass comfortably switching flies as he drowsed in the sun. The outlook was distinctly encouraging.

After a day of work near camp the geologists said they had found fossils but kept us guessing until after dinner. Then they spread their spoils upon the table. There were many bones, but so fragmentary that it was impossible positively to identify them. Nevertheless, Granger felt sure that one portion of a rib found by Berkey must be dinosaur. In that case, the formation from which it came probably was Cretaceous, or Age of Reptiles. This discovery made the region richer than our greatest hopes; for it gave us both Age of Mammals and Age of Reptiles fossil-fields to work in. Morris had a remarkable collection of insect and fish fossils in paper-shales. One piece contained a prize exhibit—

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a perfect mosquito, which had lived some ten or twelve million years ago. Berkey challenged it with a butterfly's wing so beautifully preserved that the most delicate veins were distinctly visible under a lens.

The geologists believe that these paper-shales were formed in sheltered ponds of such quiet water that insects which died upon the surface sank to the bottom and were gently covered with a blanket of sediment. As the animal matter decayed, their tiny bodies left in this matrix a perfect impression exactly like the mold an expert craftsman makes in plaster. Paper-shales are composed of extremely fine sediments deposited in horizontal layers. These separate into sheets as thin as paper and because of their texture are especially suitable for preserving impressions of insects.

We stayed until far into the night, examining the specimens and discussing the possibilities suggested by the day's work. It was so apparent that we were in an important region that Berkey and Morris decided to make a geological and topographical map of it, to serve as a type section of Mongolian geology. Since the geologists had no assistants and could not use a motor in that rough country, it was a colossal undertaking with the time at their disposal, but I knew it would be done if they attempted it.

On June 26 the rest of us moved our camp to a well at the southern end of the valley where Granger had found fossils. From the door of my tent I

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could look south to Baga Bogdo, its snow-capped peaks whiter than the clouds which always drifted about them. In the distant foreground was a long, flat-topped ridge, brick-red except for an upper grey-white stratum. Nearer were other hills and buttes of red, white and yellow sediments, sculptured by wind and rain. To the west the gravel peneplain, sparsely studded with desert vegetation, stretched away to meet the black thrust of a lava-flow; east of us, across the broken river valley, a similar gravel plain, extending far beyond the range of human sight, lost itself in the ever-changing mirage.

Summer had come in a day. The flowing waves of heat gave fantastic shapes to rocks and grass; antelopes seemed to dance on air and flying birds to run upon the ground. Lakes with reedy shores and wooded islets appeared where we knew there were no lakes, and sombre forests offered the coolness of shaded glens. It was an unreal world.

As I gazed across its menacing, yet alluring, wastes, the sky darkened and a subdued roar came out of the north. I felt a sudden blast of cold air and turned to see a storm sweep from the river valley and whirl away to the west at race-horse speed. In its wake lay a narrow trail of white—hailstones as large as pebbles. A moment later the desert was flooded with yellow sunlight, which seemed to have passed through amber glass before it reached the plain.

Larsen was standing beside me, watching the rush

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of the storm through field-glasses. Suddenly he gave an exclamation and pointed to a cloud of dust less than a mile away. In the midst of it we could see three dun-colored animals. Wild asses, as sure as fate! One was standing quietly while a huge stallion chased the other in circles.

Five minutes later four of us were in a car, speeding toward them. While we were still a half-mile away, they began to run west by south, rather slowly, now and then stopping to glance back at us. They looked very neat and well-groomed in their short summer coats and galloped as easily as thoroughbreds. Suddenly they disappeared in a shallow draw with a narrow, rocky entrance. By the time they were in sight again on the opposite side, we had opened fire. But they were more than four hundred yards away and our bullets did no harm. They ran south into sandy ground, and we reluctantly admitted that they had outgeneraled us.

The day after our arrival at the well, which we named "Wild Ass Camp," I discovered my first important fossil. We could prospect within a dozen yards of the tents; for they were on the edge of a red and white exposure. In the morning Shackelford found a beautifully preserved foot-bone of a rhinoceros, in the bottom of a deep gorge, and I was stimulated to better his discovery. After setting a line of traps in the river-bottom near the well, I was wandering slowly along the sides of the ravine, looking for fossils. In a spot only a few yards from

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the tents, my eyes marked a peculiar discoloration in the grey upper stratum, and bits of white, which looked like crumbled enamel. Scratching away the soft, claylike earth, I exposed the grinding surface of three large teeth and felt sure that it was an important specimen. The teeth literally were in powder and fell apart in a hundred tiny fragments when the supporting earth was removed.

Although strongly tempted to dig farther and see what lay below, I knew that, if I did, the wrath of Granger would descend upon my head. So I restrained myself and shouted to him to come over and pass judgment on the find. Because of its bad state of preservation he was doubtful, at first, if it would be worth removing, but he finally decided to make the attempt. Only such a master of the technique of fossil-collecting as Walter Granger could have got it out at all, and even he gave four days of intermittent work to the task. By means of fine camel's-hair brushes he removed the sand almost grain by grain, wetting the teeth with gum arabic as each minute section was exposed and stippling soft, tough Japanese rice-paper into the crevices. When the gum and paper dried, the dustlike particles of enamel were so cemented that it was safe to expose a still larger surface. Then Granger soaked strips of burlap in flour paste and bandaged the fossil as if it were a broken limb; after a day of sun this swathing formed a hard shell, in which the specimen was safe. As the work progressed, it be-

came evident that much more than a set of teeth lay buried in the hill: one side of the palate was exposed, then the jugal arch, which forms the cheek, and finally the anterior part of the skull with a pair of long, decurved nasal bones. The teeth showed that the animal was a rhinoceros of a kind that none of us knew. Subsequently it was studied by Prof. Osborn and named *Baluchitherium mongoliense*.

My initial experience as a palæontological collector stimulated me to spend every leisure moment in wandering over the bad lands, hunting for new treasures. The veriest fragment of exposed bone might lead the way to a skull or a skeleton; a single specimen might turn one more page in the pre-history of Central Asia. But I was far behind Shackelford as an amateur collector. He seemed to know exactly where the best specimens lay and always came into camp with his hands and pockets full of teeth or bones that no one else had noticed. We were certain that he had developed an extra sense whereby he could smell an animal that had died two million years ago.

Our efforts to discover fossils met with an approval that did not in the least apply to our efforts to remove them. I was inclined to employ pickax where Granger would have used a camel's-hair brush and pointed instruments not much larger than needles. When a valuable specimen had been discovered, he usually suggested that we go on a wild-ass hunt or

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do anything that would take us as far as possible from the scene of his operations.

I had so much to do that I spent only odd moments in searching for fossils during our first week at the "Wild Ass Camp." Larsen, Colgate, Shackelford and I hunted most of the day and in a very short time we learned the country thoroughly. On the gravel peneplain to the east of camp we had an exciting chase after a baby gazelle. The little fellow was about ten days old and hardly larger than a jack-rabbit. We saw him with his mother on a long hill-slope, but she left him before long and tried to entice us away by running back and forth in front of the car. We were not to be led astray, for I had promised Dr. Hornaday that I would bring both gazelles and wild asses to the New York Zoölogical Park if it were possible to catch the young animals. The baby antelope ran like a streak of yellow light, but with the car going at forty miles an hour we could overtake him easily. Then he would suddenly swerve to the right or left and, before we could turn, he had gained several hundred yards. At first he swung in a long circle about the spot where we had found him with his mother, and for four miles he seldom went slower than twenty-five miles an hour. Gradually he began to tire but ran five miles farther at an average speed of fifteen miles an hour. He was pretty well exhausted then and made frequent stops, crouching on the ground with outstretched neck, but dashing off again at

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full speed when the motor neared him. Finally he gave up and lay down. Shackelford made a flying leap out of the car, caught his foot and landed head first on top of the gazelle. We made a bed of coats in the bottom of the motor and took the little creature back to camp to add to our already large family of pets.

I got my first wild ass on the day when we caught the baby antelope. Just after tiffin Larsen discovered a fine stallion not more than a mile and a half from camp, drowsing in the sun. He stood motionless except for an occasional flick of his tail and lazy movements of his long ears. We watched him through field-glasses for a time, and then Larsen, Colgate and I started out in the car. Profiting by previous experience, we ran almost due south, to cut him off from the sandy ground on the lower plain. He seemed to divine our intentions at once and ran for all he was worth toward Baga Bogdo. Colgate "stepped on the gas" and the motor leaped forward at forty-five miles an hour. The ass could not do better than forty miles, even when straining every muscle to cross in front of us. He turned back on the plain and headed straight for the black lava-flow a mile to the west. It was thrilling when we rushed along within fifty yards of the splendid animal, the first we had seen in action at close quarters. I hated to give the word to stop, but he was dangerously close to the lava. Colgate jammed on the brakes just as he crossed in front of us. The

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first volley turned him northward and we leaped back into the car to follow. He had a start of four or five hundred yards but was going perceptibly slower. I fired again at three hundred yards. He winced, ran a few steps and rolled over, legs waving wildly in the air. We all yelled as he went down. It had been a great race and a new animal had been added to my long list of Asiatic game.

I could hardly wait to examine the specimen. He was fat, yet in perfect condition, and as large as a Mongol pony. We wondered how he kept so well fed on the dry sage-brush and desert vegetation. As a matter of fact, he was the handsomest stallion we ever killed. The yellow-faun color of the upper parts shaded exquisitely into the pure white of the belly, and down the back was a broad, dark-brown band extending straight to the root of his brown, brush-tipped tail. The short summer hair was so fine that it seemed to have been laid on with a paint-brush, and the coat was without a blemish save for two or three small scars on the neck—reminders of old battles. Larsen appraised the long-eared, trimly built animal with the eye of an expert horse-dealer. His enthusiasm knew no bounds. Right there he formed a plan to capture some of the colts (or should they be called “asslets”?) and use them for breeding purposes. What magnificent mules they would produce!

Larsen waited by the dead ass to keep off the kites while Colgate and I ran back to the tents,

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which were only two miles away. All the boys were tremendously excited; for they had been watching the chase through field-glasses from a hill. When the truck started back with the taxidermists, it carried every man in camp except the cook. Poor little fellow! He stuck manfully to his job even though he was consumed with curiosity to see the animal. When the skin was off and the skeleton had been "roughed out," I poisoned great chunks of meat with liberal doses of strychnine.

In the morning Colgate and I went to the poisoned meat and, to our intense surprise, found it untouched. But the next night produced results. Not twenty yards away lay a great wolf and off to the north was another, apparently on his way to the hills when the death-sickness overcame him. Although it was June 29, both animals wore patches of long winter fur and were most unsightly.

Besides the two wolves four kites, one golden eagle and an enormous black vulture had succumbed to the poisoned meat. At the hot spring, Larsen had shot a similar specimen which measured nine feet six inches from tip to tip of the spread wings. Vultures of this species (*Vultur monachus*) are among the largest birds in the world. I never tired of watching them sail in great circles on motionless wings almost beyond the range of human sight, waiting for the death of some creature of the desert. They were particularly abundant in this part of the Gobi. I saw one which had so gorged itself on the

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carcass of a wild ass that it could not lift its body off the ground. One day when Colgate and I returned to a dead antelope that we had left while we chased a wounded buck, a vulture flew away, and we found that in less than thirty minutes it had devoured more than half of the antelope, which weighed sixty pounds.

It was now July 1, and we had had no news of the outside world since the expedition left Urga in May. I was anxious to find out what had happened in China and to make sure that my wife and Dr. Black had reached Peking safely after their initial motor smash near our Tuerin camp. I decided, therefore, to send Bayard Colgate into Urga with a car, to get news and mail, if we were fortunate enough to have any waiting for us. To my regret Larsen and Badmajapoff both said that they must go with him; for they could not remain away from business for the entire summer. I disliked sending a single car on this eight-hundred-mile trip, but it was imperative that we should have tidings.

Shackelford and I had always hoped to catch a wild ass so far up on the gravel plain that we could cut him off from the soft ground to the south, and on July 5, shortly after breakfast, we saw one in just the right position. We circled him and to our intense satisfaction he started northward toward the upper plain, where the ground was hard and smooth. A dozen times he tried to cross in front of us, but I kept well away on a long diagonal and always cut him off. At last we came within thirty feet and,

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going at forty miles an hour, raced behind him for a half-mile. He lowered his head, and, watching us from one eye, pounded along, throwing clouds of sand and gravel against the wind-shield. Shackelford half knelt on the seat beside the camera, grinding off film by the dozen feet. Then, with a burst of speed, the ass crossed in front of the car, missing the headlights by less than a yard, and swung south on a straightaway course of five miles down grade. Shackelford and I were yelling at each other in sheer excitement: it was a race to thrill the most hardened sportsman; for we were carrying away every detail in the film and when it was all over, the beautiful animal still would be alive.

How Shackelford stayed in the car I can only guess, for the ground was rough and, when we struck a bump, there was no slowing up. The ass took us across one shallow gully with a deep trench in the bottom. Going at thirty-six miles an hour, we leaped the ditch. When Shackelford came down, he was astride the door with most of him outside. For an instant he balanced uncertainly and then toppled over into the car. I glanced around and under the legs of the tripod saw his huddled mass, from which came reassuringly wrathful groans. I knew he was not dead. By some miracle the camera had stayed on the tripod. We thanked our lucky stars for that and for the fact that a few moments later Shackelford successfully changed film while the car was bouncing over the roughest part of the plain.

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We kept at the wild race for twenty-nine miles up and down the plain, east and west, twisting and turning, sometimes managing to cut the animal off from the lava-flow by just the narrowest margin. For the first sixteen miles the ass averaged thirty miles an hour; then he began to slow down perceptibly but kept doggedly running for an additional four miles, at well over twenty miles an hour. By that time he had come to a canter and resorted to more frequent twists and sudden turns, which brought him ever closer to the dangerous lava. He finally did draw us into the flow, where we were hemmed in by great bombs and knifelike ridges. We were sure that he was lost. But he was content to stand and rest.

I came up slowly behind him and Shackelford tried to throw over him one of the tripod-ropes, which he had managed during our mad ride to turn into a lasso. It caught the animal on the nose and one ear. He tossed it off and, letting fly at the car with both heels, broke in the left mud-guard. Then he dashed out of the lava-flow and stood quietly looking at us. He had evidently decided that he could not rid himself of the roaring black thing that hung so persistently on his trail, but, although he had given up the race, he would not allow any liberties to be taken with his person.

We came up to him very cautiously and he began to walk toward camp. Just then the car of the geologists appeared on the horizon. Shackelford sug-

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gested that we take the wild ass into camp to greet them. By running in first speed, I could keep behind and steer him along at a slow walk. Shackelford jumped off to get a film of the solemn procession, but the animal saw that something unusual was happening and sprinted away at twenty-five miles an hour. Alone, I followed in the car. The rush was a short one. It brought the ass to a spot close to the tents, where he finally lay down. After he had had time to cool off, I sent for a pail of water, washed his head and neck and left him to rest until such time as he wished to leave. I should have liked to give him a feed of hay in payment for the marvellous pictures that Shackelford had taken of his race.

Granger made a trip with the geologists to their old camp up the valley and late one evening discovered a perfect dinosaur skeleton not far from the spot where Berkey had found a rib. Several days' work were required for the removal of the specimen. It was of a small species—about six feet long—and even the tiny bones of the whip-lash tail were beautifully preserved. Subsequently Prof. Osborn named it *Protiguanodon*. Since the dinosaur material found at Iren Dabasu consisted only of fragmentary bones and teeth, this find was of the utmost importance. It gave the American Museum a mountable skeleton and an opportunity of close comparison with the European and American dinosaurs of the corresponding group.

While the other men were occupied with their

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several lines of investigation, Shackelford and I spent the days in hunting and taking motion-pictures of animals and birds. One morning we ran far to the west and decided to reach Tsagan Nor, the waters of which looked temptingly near in the clear air. Before long we began to see herds of antelopes and shot two or three fine bucks. As the car stopped at a low hill, we gasped in amazement; for on every side were dozens of wild asses, singly and in groups of ten or twelve, grazing on the desert vegetation. Among them were numbers of antelopes, all bucks. The animals were quite oblivious of the car. Shackelford quickly slipped his camera on the tripod, and I ran toward seven wild asses that were gazing curiously at us not more than half a mile away. They were off in a swirl of dust, but going at forty-five miles an hour we overhauled them rapidly. Shackelford was kneeling on the rear seat, holding the camera. Suddenly he shouted, "Look at the antelopes—on the left!" I just glanced at one side and saw at least fifty antelopes, running in close formation and trying to cut in front of us. On the right the seven asses were doing their best to "cross our bows." I gave an extra push to the throttle and swung in behind the antelopes, which seemed to think that they must not run faster than the wild asses, although they easily could have reached fifty miles an hour. When the whole galloping mass was not more than thirty yards away, Shackelford, with a whoop of excitement, opened up with the camera, "shooting"

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foot after foot of film. We were right in the midst of the drove and catching clouds of gravel on the wind-shield from the beating hoofs. Never have I had such a thrill. It was worth a year of life!

A few minutes later, Shackelford yelled that a mare and her colt were coming in from the left. Out of the tail of my eye I glimpsed a little wobbly, fuzzy thing doing his best to keep up with an anxious mother. In a second I had reduced the speed of the car and swung in beside him. The little fellow was not more than three days old, and he ran in a stiff-legged, uncertain manner that was most amusing. He could not go fast, but he did not seem frightened. Shackelford found his lariat in the bottom of the car and, standing on the running board, roped the "asslet" with no difficulty. He was a most adorable little creature and seemed quite tame until we lifted him into the tonneau of the motor. Then he let fly with all four feet and well-nigh wrecked the camera-tripod, to say nothing of pounding Shackelford's legs.

Finally Shackelford had exhausted all his film, and for tiffin we went south toward the lake. It was marvellously beautiful. To the south Baga Bogdo, clothed in pink and lavender, reared its noble summit among the clouds, the great alluvial fans spreading like green velvet about the base. Between it and the water lay a long line of cream-white sand-dunes sculptured by the wind. The reedy margin of the lake was a vivid emerald green and the mir-



Mounted skeleton of Triceratops in the American Museum of Natural History, 20 feet long. This is the horned and gigantic relative, possibly a descendant, of the Protoceratops found at the Flaming Cliffs.



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ror of its surface reflected mountain, dunes and grass in all their colors. Flocks of ducks, geese and other wild-fowl floated on the shining water, followed by trailing wakes of downy young.

On our return to camp the little ass became something of a problem, because, though he drank tinned milk greedily from a canteen, we did not have enough to feed him on that alone, willing as the men were to give him their share. We hoped to get sufficient goat's milk to keep him strong until he could eat grass.

Though Berkey, Morris and Granger thought it best to remain for a time at the "Wild Ass Camp," Shackelford and I decided that we had better shift the main encampment to Tsagan Nor, where we should be in the centre of the game-region. On July 11, accordingly, we pitched our tents by the lake, not fifty paces from the water's edge, on a hard gravel beach covered by a thin carpet of grass and short weeds. We had our first dinner in the soft afterglow of the sunset, which draped a veil of delicate lavender about the fairy mountain across the lake and edged the curving shore-line with deepest purple. As we sat smoking in a silence broken only by the distant murmur of restless water-fowl, glittering light suddenly flooded the water and the edge of a golden moon showed above the sand-dunes in the east. It was peace unutterable and beauty that beggared description.

CHAPTER VIII

FINDING THE BALUCHITHERIUM

THE morning after our arrival at Tsagan Nor (the White Lake), Shackelford and I drove over to the Mongol village at the western end of the lake to call upon our neighbors. We found three groups of *yurts* facing a meadow. We were entertained in the *yurt* of the headman of the village, who gave us tea, cheese and *kumiss*, or fermented mare's milk, the simplest of home-brews, with a kick contributed by every mare. The headman's daughter, a charming little girl of seventeen, came up to me, shyly holding out her hand. The middle finger was green-black and terribly swollen—evidently from gangrene. That night she rode with her father to our camp, and I poulticed the finger. When the bandage was removed the following day, half the finger came off, to the terror of the poor little girl. But there was no inflammation in the rest of the hand, and in less than a fortnight the stump of the finger was completely healed.

Since I had cured the headman's daughter, he

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was ready to do anything we wished. I particularly asked him to keep his dogs tied up; for Shackelford wished to do a good deal of photographing in the vicinity of the *yurts*.

Because of a peculiar custom of the Mongols, the dogs are a great menace to human life. A corpse is the abode of evil spirits and therefore a most undesirable thing to have about the house; thus their chief desire is to dispose of the dead as quickly as possible.

Sometimes the body is placed upon a cart and driven rapidly across rough ground, so that it will fall off. The driver, fearful of attracting to himself the evil spirits that possess it, hurries on without looking back. Meanwhile dogs, birds and wolves make short work of the corpse. Only the bones, which every native will shun, are left. At the base of the hill upon which the lama city is built in Urga, there are hundreds of human skulls and bones, gruesome reminders to the living priests of what their own fate will be. Great black dogs slink about this "burial-ground" and fight over the bodies that are dragged out from the city. They live almost entirely upon human flesh and are terribly savage. It is certain death for a man to pass near this spot at night unless he is armed. Even in the daytime the dogs will attack a passer-by upon the slightest provocation, and if one of their own number is wounded, they seize and devour him. Berkey was attacked by three dogs at a *yurt* near Sain Noin

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Khan's and by shooting two of them with his revolver, just saved himself from being pulled down. My wife and I had a very narrow escape from death at Tuerin when we were lying in fur sleeping-bags near the motor-cars; the dogs thought we were dead Mongols and a pack of fourteen had gathered for a feast upon our unsuspecting bodies.

The Mongols object greatly to having anybody die within a *yurt*, and, when one member of a family is seriously ill, the others frequently decamp before the end comes. They run no risks of an encounter with a malign spirit. Once, when hunting on the plains, I found the skeleton of a woman lying beside the dead ashes of a fire, with a wooden bowl half filled with food. Twenty feet away was the circular mark where a *yurt* had stood. My Mongol guide explained that the woman was sick and had been left to die alone.

The routine of life in the *yurt* village near our camp might almost have been designed to please the eye of a photographer. Shackelford, companioned by his camera, was on hand at sunrise, when the men and boys drove camels and horses out to graze and the girls guided cattle, goats and sheep, and in mid afternoon, when the herders brought their charges in to be milked. He saw the milk that was to yield a new supply of cheese and *kumiss* strained through perforated vessels half filled with matted hair and then poured into the goatskins that hung on the *yurt* walls. He watched the women making

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string or rope from camels' wool or repairing their summer garments of Chinese cotton. He recorded in motion-pictures the setting up of a *yurt* and the process of making felt.

One day when I was with him, we found several families engaged in the latter task. On the plain above the valley, where the ground was hard and flat, a strip of felt was spread. Upon it two old women put a thick layer of sheep's wool. This was thoroughly soaked with water and covered with a second felt layer. The "wool sandwich" was rolled up on a long pole, wrapped in a thin cloth and tightly bound, and ropes were fastened to the projecting ends of the pole. Then a Mongol mounted on a camel dragged the cylinder behind him over a smooth path for more than an hour. This rolling pressed the loose wool firmly together into a strip of felt, and all that remained was to dry it in the sun and bind the edges.

Shackelford and I were as pleased as children to show off our new headquarters at the White Lake to Bayard Colgate. He had reached the "Wild Ass Camp" on the evening of July 11, with mail for all the men except poor "Shack," whose letters were somewhere in the Gobi with others for the rest of us. Colgate made the run to Urga in two days and spent the same time on the return trip—altogether nearly eight hundred miles. He was away just nine days, an exceedingly creditable performance.

The Tsagan Nor region offered a fruitful field for

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my studies as a zoölogist. The lake and its shore swarmed with wild creatures. We found the beautiful bar-headed geese, so well known in India, breeding there in numbers. We also noticed swan-geese now and then, although they usually keep to the rivers, and in August, while sitting in my tent, I saw seven geese which were new to me. By wading into the water, with my gun held above my head, slowly I got within shooting distance and killed two. They proved to be greylags, geese which are common in Europe but extremely rare in northern China. Shel-drakes of two species, grebes and a multitude of shore-birds, waders, gulls and terns were always running about the beach in front of our camp. One night the taxidermists caught a shrew in their tent. This tiny insectivore is an inhabitant of damp, soft ground. Had I seen a wild elephant on the plains, I should hardly have been more surprised than to find this diminutive animal in the desert. Another curious insectivore was the hedgehog. Almost every evening Buckshot, one of our Chinese assistants, spent the first hours after dark along the lake-shore, hunting hedgehogs with a flash-light.

Shackelford adopted one of the little spiny fellows, and he became our most amusing pet. He was named "Johnny Tsagan Nor." He is now in the New York Zoölogical Park; for, on leaving China, Shackelford refused to be separated from him. The hedgehog, although not more than eight inches long, was a most voracious eater and did not limit him-

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self to insects. A short time after our return to Peking, Clifford Pope brought a baby alligator about fifteen inches in length from the Yangtze River. The alligator and Johnny Tsagan Nor were left together over night in a large packing-box in the laboratory. The next morning the reptile was dead and partly eaten. Johnny had been hungry.

Two genera of beautiful kangaroo-rats lived in the plains behind the tents. If a car came in at night, we could see them in the path of the headlights. I often tried to catch one, but it could jump six or eight feet and always got over the ground faster than I could run. There were foxes in the long grass beside the water, antelopes and wild asses swarmed upon the plains behind camp and bighorn sheep and ibex roamed over Baga Bogdo.

In the land-locked lake itself there were fish, we knew from the good-sized swirls on the surface, but our hooks and lines yielded no results. By means of a twelve-foot net, however, we got numbers of minnows and small fish six or eight inches long. Several hundred specimens of these were preserved in formalin.

Tsagan Nor, which is fed by springs, is now three miles long by two miles wide, but evaporation is so rapid that the lake is becoming smaller. In 1925 it dried up entirely. Berkey and Morris counted seven ancient beach-marks, the highest of them twenty-eight feet above the present water-level. A depression that was evidently the old lake-floor ex-

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tends for a long distance to the west. Colgate and I followed it for thirteen miles, and later we found that it reaches Orok Nor. Doubtless this was once a continuous body of water. On the south side of the basin, at the foot of the mountains, is a long, narrow belt of live sand-dunes. Very often in the afternoons we watched wind-storms sweeping over them and could see the sand streaming off the tops of the dunes like spray from gigantic waves.

Granger, Berkey and Morris never allowed themselves a moment's play, but I insisted that they all come to Tsagan Nor on July 18 to a field-meet that the Mongols were to hold under the direction of our friend, the headman, whose daughter's hand I had treated. Two weeks before, he had sent out riders to invite the people from the various *yurts* within a radius of fifty miles. The programme included pony-races, wrestling, camel-races, roping and riding of wild horses and, best of all, a big feast of boiled mutton.

Because of their love of athletics and of life in the open, the Mongols seem to me less difficult than the Chinese for a Westerner to understand. Anybody with a sense of humor can get on well with the Mongols; for they too have that good quality along with their sportsmanlike point of view. They are fond of a practical joke and can appreciate it even when the laugh is on themselves. One day a Mongol rode up to my camp, carrying a big wooden pitcher of milk. Something frightened his pony,

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which began to buck like a western bronco. At every jump the milk splashed out, until finally it had drenched the Mongol from head to foot. It would have been a terrible loss of "face" to drop the pitcher, but when finally the pony was quieted and not a drop of milk remained, the Mongol himself laughed as hard as the rest of us. Many amusing stories are told of the Living Buddha's love of fun. It is related that, when he bought the first motor-car that came to Urga, his chief delight was to connect a wire with the batteries and stretch it across the courtyard, into which he could look from a window of the palace. There he would sit and roar with laughter when his visitors and ministers of state received a shock.

The geologists and Granger arrived a little after nine o'clock in the morning, and with the cameras set up in one of the Fulton trucks we went over to the village. A crowd of men and boys, dressed in red, yellow and plum-color, had gathered on the plain, so that it was a gorgeous assemblage. Fifty ponies had already gone five miles to the east, and, when we left camp, a Mongol rode off at full speed to start the race. I wanted them to run only two miles, but the Mongols would not consent to that. Their usual distance is from seven to fifteen miles, but we finally compromised on five miles. It is merely a question of a pony's endurance, because the Mongols have very little real understanding of horsemanship, although they are excellent riders and

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will start off at full speed even at the beginning of a race. At last we saw a cloud of dust in the distance and could distinguish the ponies, coming toward us in an irregular line. The riders were all boys, ten or twelve years old. A beautiful bay, ridden by a lama, came in an easy winner, and the little lama was the proudest child in all Mongolia. After the race the Mongols rode in a circle about a group of priests, chanting a barbaric song. The moving ponies and the brilliant colors made it seem like a "Wild West" show or an enormous circus.

The race of the camels interested us greatly for it was amazing to see how quickly the ungainly brutes got away on the start and what speed they could develop. At the finish a man on a fast pony had all he could do to keep abreast of them. The riding of wild horses was a bit disappointing, for only one animal gave the natives a really bad time of it. The Mongol pony does not know how to buck or "sunfish" as do our bronchos and contents himself with merely plunging.

The wrestling, in which some thirty men competed was good sport. One burly fellow, who massaged himself thoroughly with saliva just before the match, won two falls with ease but was eliminated on the third, with great hurt to his pride. The winner received a frightful cut over the eye in his last bout but finally threw his man, although completely blinded by blood.

When the meet was ended, we all repaired to the

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headman's *yurt* for the feast. The Mongols obediently waited until Shackelford was ready with the camera. Then two huge wooden troughs containing six sheep were brought out. Nothing had been wasted. The fat and blood had been poured into the intestines and boiled to make enormous sausages. A most uninviting mess it was. As each of the two hundred men secured a chunk of mutton, he retired to a sunny corner, crammed his mouth full, and, as he began to chew, cut off the end of the meat close to his nose. We laughed until our sides ached while Shackelford recorded the choicest bits of this comedy on his film.

Berkey and Morris, who had returned to camp with all their duffle, left us on July 28 with three camels and three ponies besides a cook and two Mongols. Their destination was the southern side of the lake to complete their map to the foot of Baga Bogdo. Thus the Expedition was pretty well divided: Granger and Shackelford at the "Wild Ass Camp"; Colgate and I at Tsagan Nor; Berkey and Morris skipping about all over the south side of the lake. When planning the work in Peking, I had foreseen the need of such separations and had arranged three units for the Expedition; each one had its own chauffeur, cook and camp equipment and could operate independently.

The day after he joined Granger, Shackelford, while prospecting a river-bed, actually stumbled over a huge bone, which proved to be the head of the

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ulna, one of the lower bones of the fore limb, of a *Baluchitherium*. Berkey had discovered a calcaneum, or heel-bone, of the same beast at Iren Dabasu, but none of us had connected that fact with the report made by the Mongols that in the locality of the "Wild Ass Camp" there were bones as large as a man's body. Shackelford's discovery that this story was not mere native exaggeration set us all on edge with excitement. I went with Granger to the place where the ulna had been found, but no other fragments of the skeleton could be located, although we searched the dry stream-bed and the surrounding hills.

On August 3, just as Colgate and I had finished our dinner, we heard shouts and found that Berkey and Morris had arrived. From then until midnight we listened to the story of their wanderings and discoveries. They had been astounded at the tremendous scale of everything at Baga Bogdo. One of the alluvial fans, which they had ascended, was ten miles from base to crest and two thousand feet high. Others were much larger. Berkey said that in all his previous experience he had seen none that even approached them. The mountain itself rose about twelve thousand feet above sea-level. It would be hardly possible to find a more varied and representative section of Mongolian topography. The two men had lived with it early and late for six weeks and had mapped eight hundred square miles. Yet when they stood on one of the lower peaks and looked

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across the vast panorama spread out below them, they felt that they had mapped only a postage-stamp.

The evening of the geologists' return was exciting enough to keep me awake long after the lights were out, but the next was still more memorable. Late in the afternoon there was a little rain and just at sunset a glorious rainbow stretched its fairy arch from the plain across the lake to the summit of Baga Bogdo. Below it the sky was ablaze with ragged tongues of flame; in the west billowy, gold-margined clouds, shot through with red, lay thick upon the desert. Wave after wave of light flooded the mountain across the lake—lavender, green and deepest purple—colors which blazed and faded almost before they could be named. We exclaimed breathlessly at first and then grew silent with awe. We felt that we should never see the like again. Suddenly a black car, with Granger and Shackelford in it, came out of the north and slipped quietly into camp. Even Shackelford's buoyant spirit was stilled by the grandeur of what was passing in the sky. Not until the purple twilight had settled over mountain, lake and desert, did the two men tell us why they had been so late. They had discovered parts of the skeleton of a *Baluchitherium*!

During the entire Mongolian expedition the best localities for fossils and the finest specimens were discovered when we were on the point of leaving a region for other fields. So it was with our greatest

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find, the *Baluchitherium*. On breaking camp Granger and Shackelford decided to walk through a still uninspected pocket in the bad lands and to have Wang, their Chinese chauffeur, drive their car ahead to a promontory two miles to the south. After a little, Wang, bored with waiting for them, decided to do some prospecting on his own account. Almost immediately he discovered a huge bone in the bottom of a gully that emptied into a ravine. Full of excitement, he climbed back into the car, and, when Granger and Shackelford arrived, proudly conducted them to the spot where he had found the fossil. It was the end of the humerus, or upper fore leg-bone, of a *Baluchitherium*, and other parts were visible, partially embedded in the earth. The most important of all was one whole side of the lower jaw. The bones were very well preserved and the men removed without difficulty all that they could discover. They searched the sides of the gully until the approaching sunset warned them to be on the way to Tsagan Nor if they wished to reach camp before dark.

I went to sleep very late that night, with my mind full of *Baluchitherium*, and had a vivid dream of finding the creature's skull in a canyon about fifteen miles from the spot where the jaw had been discovered the day before. When I asked Granger the next morning if he was sure that all the bones had been located in the somewhat hurried search, he said: "Well, it is possible that under the spot where

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we found the jaw there may be a skull or other bones not yet exposed by weathering." Since he himself was busy packing fossils to go by the caravan, which had reached Tsagan Nor and was making ready to start ahead of us, he suggested that Shackelford and I go to the "Wild Ass Camp" with Wang and dig up the bottom of the wash.

We did not leave till after tiffin; for it was only twenty miles—an hour's run for the car. On our arrival Shackelford and Wang set to work with shovels while I inspected the side of the gully, now and then sticking my pick into a bit of discolored earth. In about three minutes I reached the summit of the tiny ridge and looked down the other side. Instantly I saw a fragment of bone peeping out of the sand in the bottom of the wash. Its color was unmistakable. With a yell I leaped down the steep slope. When Shackelford and Wang came round the corner on the run, I was on my knees, scratching like a terrier. Already a huge chunk of bone had been unearthed and a dozen other fragments were visible in the sand. They were beautifully fossilized and so hard that we had no fear of breaking them. Laughing in hysterical excitement, we made the sand fly as we took out piece after piece of bone.

Suddenly my fingers struck a huge block. Shackelford followed it down and found the other end; then he produced a tooth. My dream had come true! We had discovered the skull of a *Baluchitherium*! One end of the block was loose and easily removed;

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the remainder appeared to extend indefinitely back into the earth. When Shackelford loosened the first tooth, I knew that it was time to stop if the wrath of the palæontologist was not to descend on our heads. Therefore we collected all the fragments and carried them up the slope to the car. No new-born baby ever was handled with more loving care than we bestowed upon those precious bones as we packed them in coats and bags, so that they would ride safely.

At six o'clock, while the men were having tea, we burst into camp, shouting like children. Granger has made so many interesting discoveries in his palæontological career that he is not easily stirred, but our story brought him up standing. Then silently and carefully he inspected the bones in the car.

We held a council over the largest of them, which was partly embedded in rock. It was difficult to identify at first; for we were dealing with an animal virtually unknown. At last Granger decided that the bone was the front of the skull. Then we made out two great incisor teeth and the bones of the maxillæ and premaxillæ. There was no doubt that we had also the posterior part of the skull; for I had identified the great occipital condyles and the neural canal, through which runs the spinal cord. Even though we had realized that the *Baluchitherium* was a colossal beast, the size of the bones left us absolutely astounded. The largest known rhinoc-



Granger examining a Titanotherium skull exposed in the cliff at Ulu Usu, 1923.



Battlement Bluffs at the Flaming Cliffs where the dinosaur eggs were first discovered.

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eros was dwarfed in comparison; for the head of this animal was five feet long and his neck must have been of pillar-like proportions.

Early in the morning Colgate, Granger, Shackelford, Wang and I set merrily forth in one of the Fulton trucks for the scene of the great find. Shackelford and Walter lay back in camp-chairs, singing at the top of their voices. I suppose that fossils never were collected under happier circumstances.

When we arrived at the bottom of the gully, Granger and I made a careful examination of the skull. We decided that it was lying on its right side and that the left arch and tooth-row were gone. Later we found these conjectures to be correct.

Granger, Wang and I sifted every inch of the sand and gravel in the bottom of the wash, salvaging bits of bone and teeth. Granger carefully worked around the skull itself. While he whisked out the sand, grain by grain, the rest of us scattered over the surrounding bad lands to see if we could locate other bones. The skeleton had evidently lain near the summit of a ridge left between two gullies and had broken up as the earth weathered away and heavy rains fell. Part of it had gone down one side of the slope; this was what Wang had found the first day. The rest had rolled into the main wash, where I discovered it. And now Shackelford picked up a half-dozen important skull fragments, out on the plain at least three hundred yards from the ravine.

It took Granger four days to remove the skull;

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for it had to be encased in a shell of burlap and paste for safe transit by motor, camel, railroad and steamship, to New York.

In the meantime we made several short excursions. But it was already August 9 and, although the weather was still hot, geese and ducks were flocking and sand-grouse were flying eastward in countless thousands. I did not need these signs to tell me that winter was approaching and that it was time for us to take the trail. Yet we could not leave until we had spent a day at a grey bluff across the lake where Berkey and Morris had found Pliocene fossils. Cars could not possibly cross the sand-dunes; so on August 10 we set forth on camels.

The next afternoon the other men found some fine things in the grey beds, but I had the best luck of all. While inspecting a knoll of yellow gravel, I noticed a few fossil bits at the very base. Following them up, I came to a slight discoloration in the earth and saw a half-inch of bone exposed. Since I had found the calcaneum of a mastodon a few moments earlier, I thought that this was the end of a tusk, which very likely was fastened into the skull of a proboscidean. I scraped away the earth and soon realized that the fossil was not an elephant's trunk, but the antler of a stag—as perfect as if it had been dropped the day before instead of nearly a million years ago. I had long been interested in the living Asiatic wapiti because of its relationship to the elk of western America and to the red deer of Europe,

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and it was probable that in this very fossil we might have the ancestor of them both.

The actual removing of the antler was too delicate an undertaking for my pick-and-shovel methods; so I walked to the end of the knoll and fired three shots with my automatic pistol to bring up Granger and Shackelford, who, I knew, were somewhere in the maze of gullies below me. Before long they appeared, hot and puffing; for among the members of the Expedition such a signal meant that every man within hearing distance should not stand upon the order of his coming, but come as fast as his legs could carry him. Though it was then six o'clock, Granger was able to paste the antler with gum arabic and rice-paper and remove it.

As the sun was setting, we started for the long ride to camp. Before we had entered the dunes, darkness had fallen and a strong wind blew from the east. We urged our camels to their best speed; for it would have been decidedly dangerous to become lost in that drifting maze when a sandstorm was in progress. But before we left the last of the fantastic waves behind us, the wind dropped as suddenly as it had risen, the thickly piled clouds on the horizon disappeared and a glorious moon lighted us home.

CHAPTER IX

THE DISCOVERY OF THE FLAMING CLIFFS

BY noon of the second day after the reassembled units of the Central Asiatic Expedition had set out from Tsagan Nor, we were opposite Artsa Bogdo, a low-lying, rounded mass ten miles south of the trail.

The tents were pitched on a grassy slope a thousand feet above the plain and right at the base of the mountain. Before us unfolded a magnificent panorama of desert and "bad lands," and about the camp itself there was a delightful atmosphere of cleanliness, height and freedom. We all looked forward to a pleasant fortnight, for the Mongols assured us that there were many sheep and ibex in the mountains, and the bad lands looked decidedly possible for fossils.

But it was necessary first to plan the days ahead, for we must reach Sair Usu, a well in the desert, three hundred miles to the east on the homeward trail, by September 5. Almost as soon as Merin and the camels arrived at Artsa Bogdo, we started

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the caravan on its way to Sair Usu. But before it left, Berkey and Morris hired ponies and camels to use on a seventy-mile trip across the Altai Mountains to the Gurbun Saikhan. Then I saw Granger off on a fossil hunt to the north.

So far everything had gone well at Artsa Bogdo except for the death of the baby wild ass that had lived with us for two months. Buckshot, our Chinese boy, had fed the little animal on tinned milk and then on the milk of three goats purchased for its benefit, and in our new camping-place he had obtained for it plenty of cow's milk. The ass only tolerated the rest of us, but it looked upon Buckshot as "father, mother and great provider." It followed him around like a dog and did not like being separated from him even when he was busy in the cook-tent. Yet in spite of his care, it did not thrive, and on August 18 I had to tell him that I thought his pet would die. So, according to Chinese custom, Buckshot dug a grave in the bottom of the valley. When he returned, the ass was standing up. Buckshot was radiantly happy, for he thought that it would recover. But it died that night. It was with tear-filled eyes that the poor boy heard us speak of it at breakfast next morning. He was inconsolable.

Soon after Granger set out to look for fossils, I left the camp in charge of Shackelford and Colgate and started with Tserin and a lama hunter for the western peaks of Artsa Bogdo. The hunter said

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we must have the lightest outfit possible and sleep among the peaks wherever we found animals. We took only sleeping-bags, therefore, and food enough for five days on a led pony.

After riding for nine miles along the base of the mountains, the hunter discovered a herd of ibex on the very summit of one of the highest peaks. With the glasses I could make out three bucks among them—one a perfectly splendid fellow with long, annulated horns that swept backward in a graceful curve. On the climb to the peak where they were wandering among the rocks, now and then cropping the grass, we were delayed for a half-hour by a female ibex and three young. They stood motionless not fifty yards away, gazing at the boulder behind which we were concealed, and I thought that they would never go. When they finally decided to leave, we slipped over a ledge of rock and looked into a deep valley. Three hundred yards below us were the bucks in all their majesty. I waited until my heart had stopped pounding and then fired at a big fellow who stood out like a giant among his children. He dropped in the long grass at the crash of my rifle and the others sprang away out of sight. A few moments later they reappeared on the opposite side of the ravine and stopped to look about them. It was long range—well over four hundred yards—but in the crystal-clear air they were perfectly visible, and I sent one of them tumbling off the rocks with a broken neck.

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The Mongol was wildly excited, for he had never seen a high-power rifle in action and thought it madness to shoot at such a range. But our joy was changed to chagrin a half-hour later when we reached the spot where the big buck had fallen. There was a pool of blood but no ibex. Because of the long grass we could not follow the trail more than a few feet and at last we had to admit that the animal was hopelessly lost. The other, which was stone dead, did not compare with the leader of the herd, but he carried a beautiful pair of horns. While I ate tiffin, the Mongols skinned the carcass.

Then we continued eastward and soon turned into a canyon that led us deep into the mountains. The river-bed was dry except at one spot. We filled our canteens and two water-bags, for the hunter said we must sleep that night on the very summit of a mountain that rose like a sheer wall two thousand feet above. The summit of the peak was marked by a series of projecting rocks like the spine of a gigantic reptile. In one side was a narrow cave just big enough for a man to lie at full length, and in this I spread my fur bag. The hunters slept on the opposite side of the ridge.

The next day we saw much game but got little and camped in the evening under even greater difficulties. Tserin had remained in the bottom of a canyon while the hunter and I went up the mountain and, when we signalled him to come, he lost himself in a maze of undergrowth. We both had to go down

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to help him, and it was after midnight before we had half pulled, half lifted the ponies to the peak. All of us were done for. Nevertheless we were there, and in the morning would be right among the game, without wasting time in a heart-breaking climb.

Two buck ibex were seen within five hundred yards of camp shortly after daylight. Though their horns were not bad, I decided to let them go. Ten minutes later I was devoutly thankful, for on the far side of a steep ravine nineteen ibex were quietly feeding. All were bucks and eleven of them had such magnificent horns that it was difficult to select the largest. The Mongol hunter made a fine stalk, and a half-hour later we slithered down a grassy slope to the shelter of a huge boulder. When I peeped from behind it, the whole herd was within a hundred and fifty yards. Just as one fine animal was nipping a bunch of grass, my bullet struck him in the side. There was a rush of brown bodies, and eighteen ibex swept up the mountain. I waited, hoping that they would stop, but they charged over the summit like a troop of cavalry. I got in two more shots and saw a superb buck roll down the hill. Then the ravine was silent save for the whistling of a frightened cony. In ten minutes it was over, but in my life as a sportsman that day stands out above all the others.

The next summer McKenzie, Young and I had a more interesting hunt in these same mountains. We had left camp early in the morning and after a day

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of gruelling climbing we lay in our fur sleeping-bags on the very summit of Artsa Bogdo looking up at a bespangled sky. The weird hoot of an owl came faintly from the rocks to the west, and presently the great bird sailed on noiseless wings across the face of the moon. A breeze fanned our cheeks; then came a frightened snort and a clatter of hoofs as a band of mountain sheep, feeding on the lower slopes, caught the man-scent on a swirling gust of wind. It was very still up there. Perhaps it was the silence, and the clear brilliance of the night, that long kept sleep from our tired eyes.

Somewhere in the chaos of ragged peaks to the north of us was a band of ibex. We had come upon them suddenly late in the afternoon, but a silhouette of curved horns and tossing heads was all we saw as the herd paused for an instant on the crest of a knifelike ridge. It was enough to show that the animals were bucks and big ones.

As we slowly studied each ridge and slope through our field-glasses, there came into the circle of vision a long valley, tinged with the yellow-green of departing summer. Two black dots showed in the very bottom, and farther up the side a dozen more. Certainly they must be sheep; for they were at least a mile away and ibex never would feed so far from the higher rocks.

A series of beautiful grassy slopes led down the valley, and our ponies were fresh. When we were in the saddle, our lama hunter and Tserin looked

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back with a laughing challenge; for a Mongol values horsemanship above all else and has come to believe that a white man at best can only be a poor second in a race. But here, just the same, we rode together. Kicking our ponies, we swept down a gentle slope and up the other side, four abreast. Then we swung along a hillside, still racing neck and neck, and came to a halt behind a rampart of grey rocks.

Slipping out of the saddles, we hobbled our ponies and stole up to the summit of the outcrop. The sheep were there, much closer than we had thought, but the four in sight were ewes. While we watched, a female with two kids appeared from around a corner; then a second and a third, until thirty animals were quietly feeding not more than two hundred yards below us. As each sheep appeared, we hoped for a sight of big horns, but not a ram was in the herd.

It was too late to find others, so we settled ourselves comfortably to observe the ladies with their children. The youngsters frisked about, kicking their little legs in the air, now and then having friendly tilts with their companions and rushing at one another in the most determined way. Even though the sheep felt themselves to be safe, they continually raised their heads to stare in every direction or to sniff the air. Never for an instant did they relax their watchfulness. What a life to lead, always with the fear of death present in their minds! Death from men and death from wolves! Even then it lurked behind the rocks with us; for, had we not

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been there, our Mongols would have slain the females. Meat is meat, and the flesh of ewes is better than that of rams.

Not a breath of wind had stirred the grass until just as the sun sank below the western peaks; then the evening breeze came lazily up the valley, played for an instant among the rocks and passed over the crest. Instantly there were startled snorts, a rush of feet, and the hillside lay empty in the twilight shadows. The abrupt ending to the peaceful family scene left us thoughtful. We lighted our pipes and wandered slowly back to the grazing ponies.

"Let's go home," I said to Mac, and, as we rode on in the stillness of the summer night, I thought of what the word had meant to me since I had begun to wander fifteen years before. Tonight "home" was the spot where we had left our sleeping-bags on the saddle between the peaks! In the painted desert of Gobi; in steaming Borneo jungles; among palm-trees on the enchanted islands of the East Indies; in the wilderness of Korean forests; on the summit of the Himalaya; along the fog-bound shores of Bering Sea—wherever I made my little camp-fire, there was "home." But it has been a happy life and a full one. Not for an instant would I have changed it for the static existence of a palace on Fifth Avenue. As I looked across toward the peaks where we had seen the ibex, I thought that there was the "Valley of Content."

Ibex, of course, are true wild goats, with curving,

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annulated horns and long beards such as any respectable goat ought to wear. They live in Abyssinia, the Caucasus and the mountains of Central Asia, and they hold an enviable place among a sportsman's trophies; unless a man has nerve, endurance and skill in stalking, and unless he can shoot straight, he had better not follow their trails. In the summer it is useless to hunt them during the middle of the day. Then they sleep, but, when the shadows lengthen in the ravines and valleys, they rise from their hillside beds to feed upon the darkened slopes. A saddle or depression on a ridge is a favorite sleeping-place because there the wind reaches them from every side. They depend less upon sight or hearing than upon the sense of smell to protect them from enemies. They know by instinct those places "where the baffling mountain eddies chop and change," and the slightest taint of man-scent in the air sends them off.

The Mongols have wonderful eyesight—twice as good as that of an ordinary white man—and we had learned to trust it far more than our own. Therefore, whenever we came to a ridge, our lama and Tserin would give it the first survey. With their heads barely showing above the rocks, they would scan every inch of the hills and valleys. It is difficult enough to see an ibex even when he is standing up; for his brown hair is exactly the color of the rocks and grass; when he is lying down and motionless, he is well-nigh invisible.

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Ibex never are off guard. Two or three sentinels are posted even when a herd is feeding. One day Mac and I watched forty of the animals graze up an almost perpendicular mountain-side until the last inch of shade had disappeared, and then dispose themselves comfortably among the rocks. They were plainly visible while they remained standing, but one by one they faded from sight and seemed absolutely to sink into the ground. Only two bucks were left. They climbed lazily to the highest peak and took stations side by side but facing in opposite directions. One surveyed the vast complex of mountains to the south; the other gazed over the plain, which stretched away like a calm sea. For two hours they stood motionless, living statues silhouetted against the sky. Then at the same instant they left the sentinel post and lay down to sleep. "Ten o'clock and all's well."

As for that early morning hunt, our lama, with the uncanny instinct of the native who has spent all his life in watching game, knew exactly where the ibex we had seen the night before ought to be, and he went there as straight as the crow flies. When we had been examining the hillsides for ten minutes, Tserin, with an excited exclamation, pulled me violently backward behind the ridge and pointed to a low saddle five hundred yards away. "Horns, ibex horns," he whispered in Chinese. I could see them clearly with the glasses, but they lay in such a position that I thought they must have been left

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by a native hunter who had killed an ibex on the ridge. Mac thought so, too, but the Mongols were insistent. For fifteen minutes we watched those horns; then they moved slightly, and we knew that an ibex, very much alive, was wearing them. Fortunately the wind was blowing from him to us, and, after a long circle to keep out of sight, we stopped at the base of a spur just over the crest of which he was lying as he drowsed in the sun.

Tserin and the lama went up the steep slope like cats, but Mac and I took our time. It was useless to arrive with our hearts beating like trip-hammers. Hidden by a spire of snow-white quartz rock, we waited until we were breathing smoothly. Then I motioned to the little hunter. He slowly raised his head, got to his knees and stood upright. Taking a cautious step, he sharply ducked his head and pointed below. As he moved forward, I saw a splendid buck ibex, looking fixedly at me, less than a hundred yards away. He was off with a snort of surprise just as I caught a glint of his horns through my peep-sight and fired. The bullet struck the ground on the opposite side, and he staggered slightly but kept on. Mac's rifle was crashing like a machine-gun beside me, and I saw an ibex roll over and over down the hill. Just as the herd rounded a sharp corner of rock, I snapped at the rearmost animal, a fine buck with long scimitar-like horns. He went to his knees, got up and disappeared behind the outcrop, but I knew I had him. We sat down quietly to watch the herd.

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The echoes of the last shot lost themselves in dull mutterings in the depths of a black canyon across the valley. Heavy silence settled upon the mountains. A flock of snowcocks sailed across the ravine, uttering their weird call—a note like that of no other bird on earth—which seems to fit these wild peaks. Then came a rush of wings and a shadow. I looked up to see a *lämmergeier*, that splendid vulture of the Altai, sweep down in a magnificent curve toward a tiny, whistling cony, which dived to shelter just as the bird's great claws clicked upon the rocks.

Far in the distance a line of black dots moved slowly on a mountain-side stretching up and up—so vast that it seemed to reach the sky's blue canopy. With the glasses we could see that one lagged far behind the others; then it was cut from sight by a giant boulder and did not reappear. Without doubt it was the ibex that I had hit at the first shot.

When we arrived, he was lying among the rocks, and jumped out so suddenly that he almost upset Mac, who was waiting directly in his path. Two more shots and he was down for good. He carried a beautiful pair of horns, thirty-six inches long, which swept up and back in a graceful curve to form half the arc of a circle. His long brown beard tipped with black gave him a patriarchal look, and his yellow eyes were very like those of a goat.

I looked at him with little pride in what I had done. He was so splendid a creature, had weathered

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so many storms, fought so many battles among his kind, and had struggled so gamely at the last, that I would gladly have sent him on his way with the others of the herd, could I have given him back his life.

Years of shooting have bred a change within me, and I care less and less to kill. I was born a sportsman. In memory I see myself, an eager little boy with a single-barrelled shotgun on my shoulder, trudging through the forests of southern Wisconsin. Every waking moment out of school I spent in a canoe on the river or in the fields. In the spring the damp, sodden smell of the marshes, the honk of a wild goose sounding faintly through the fog, the sight of a long black line of flying ducks, sent the blood rioting through my veins. I was tortured by school and mad to be out. Cold, wet, hunger meant nothing in the exquisite delight of seeing a duck pitch headlong into the marsh at the roar of my gun. One bird in a day's hunt made it all worth while; two or three sent me home walking on air, blissfully happy. On Sunday, when I was not allowed to take my gun, field-glasses and a note-book were the substitutes. I walked just as far and worked just as hard, but often returned at night with fever in my blood, because on those days I saw the rarest game.

It was inevitable that I should live a life that gave me the wild places of the world as a playground. It was never a matter of choice; I could have stood nothing else. I wanted it so intensely that, had I

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been shut within the four walls of an office, I should certainly have sickened and died.

In years of wandering I have shot many kinds of game in many countries of the world. There have been moments when I thought my cup was full of happiness as I gazed down upon an animal that, by skill in stalking and straight shooting, I had taken as a trophy. But now that satisfaction comes less often. The last breathless moments of the stalk, the tense concentration of the first shot and the thrill of seeing an animal go down are too quickly over. My triumph leaves a vague unhappiness. I wish it could be undone. I would give back life to the creature against whom I have matched my skill—and won. Rather a thousand times carry away his portrait on a camera negative or a motion-picture film! *That* is the real sport. All the thrills of the stalk and the final shot are there; for the achievement is not only ten times more difficult but it leaves the beast his life.

We left the camp at Artsa Bogdo on August 30, so that the geologists might have an opportunity to look over the country where Granger was working. But the increasing sharpness in the air was a warning to put the long stretch of unknown desert behind us without delay, and the appearance of a blanket of new snow on Baga Bogdo, eighty miles westward, forced me to announce that nothing except the discovery of the "Missing Link" himself would keep us after September 1. It was not the

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fear of cold but the prospect of early snow that worried us. We had had an experience with snow and mud on the way from Urga to Tuerin and remembered the helplessness of the motors. In the winter, when the ground is frozen, light snow is of little consequence; but in the autumn it forms a sticky mud that is the most difficult terrain imaginable for cars to plow their way across.

On reaching the spot where Granger had been camping, we found that he had moved to a well twelve miles away. But there was still a day's respite, and after tiffin Berkey, Morris and Colgate put their sleeping-bags in a car and set out for the well while Shackelford and I amused ourselves shooting sand-grouse. They are birds remotely related to the pigeons and have a strange combination of characters. The wings are so long and narrow that the birds can fly like bullets. The body is like a pigeon's. The head resembles that of a grouse. Most interesting of all are the feet, which are padded, as are those of a camel, to facilitate walking on the sand and gravel of the desert. The birds were in countless thousands in certain localities, and every morning they used to pass over our camp on the way to pools of water of which they alone had knowledge. We did not find their eggs or young during the first season in Mongolia and never saw any immature birds. Walter Granger insisted that we had discovered a new bird—one that did not lay eggs but reproduced itself full-grown! However,

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we did find both eggs and young, in the summer of 1923, and convinced Granger, much against his will, that sand-grouse were only ordinary birds after all.

When the men returned on the evening of August 31, they had a wonderful story to tell. Granger had discovered an enormous Cretaceous bad lands basin in which there was a dinosaur "under every bush." He had not wasted an hour of daylight for over a week and had removed two complete, excellently preserved skeletons of small dinosaurs. Even the tiniest bones of the lashlike tails were intact. He had also found parts of giant herbivorous and flesh-eating dinosaurs and had left several skeletons marked for future excavation. During his entire stay he had prospected only a half-day and with Wang, the chauffeur, had found such an abundance of fossils that he could not attempt to remove them all. Just think—this in a country where never a dinosaur was known until we came! Since Granger pronounced the bones found by the geologists on the Gurbun Saikhan to be dinosaur, the Cretaceous deposits were thus extended far to the south and east.

Everyone was enthusiastic over the beauty of the great flat-topped mesa on the border of the bad lands basin. Its surface was covered with black lava but the sides were blood-red. Even as I saw it thirty miles away through field-glasses, from the summit of one of the peaks, it was an impressive sight. The men said that against the sunset glow it surpassed anything of its kind that they had ever seen.

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September 1, the day of our departure, was marked by perfect autumn weather with air like wine. We ought to have made good progress, but spent the better part of three days in a futile search for a small trail said to lead north to the old Chinese post-road that would take us to Sair Usu.

We had seen no Mongols for nearly one hundred miles and when, at last, three *yurts* were sighted a considerable distance off the trail, the fleet halted while I ran over to make inquiries. In the meantime Shackelford walked one-half mile toward the north to investigate some peculiar looking mounds that were conspicuous on the plain. He found that he was on the edge of a great red basin which was invisible from the small trail that we were following. He decided to spend five minutes looking for fossils, and if he did not see bone immediately to return to the cars. Walking over the cliff half way down the steep slope to the basin floor, he discovered a white skull about eight inches long resting on the summit of a sandstone pinnacle. He picked it off and hurried back to the fleet. We all examined it with the greatest interest. None of us had ever seen its like. Granger was only able to say that, without doubt, it was a new type of reptile. The find was obviously so important that we camped where we were and spent the two remaining hours of daylight in searching for fossils in the beautiful ravines and on the slopes of the sandstone buttes which filled the basin.

The spot was almost paved with bones and all

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represented animals which were unknown to any of us. Granger picked up a few bits of egg-shell which made us believe that we had discovered a late Tertiary deposit. These eventually proved to be bits of dinosaur egg-shell, and the great basin with its beautiful sculptured ramparts was the richest locality of the world from a palæontological standpoint. We named it The Flaming Cliffs.

It was not until the following summer, however, that we discovered what a valuable deposit it was. Our first indication was when I received a cable from the American Museum of Natural History stating that the unknown reptile skull which Shackelford had found was in reality the ancestor of the Ceratopsians, a group of great horned dinosaurs of unknown ancestry, which were known only from America.

The next morning, when we started with a Mongol guide through the basin to the Sair Usu trail, one hundred and fifty miles away, we ran into a maze of "nigger-heads" and sand. It was one of the hardest days of our entire trip, but in the late afternoon we came out on a hard, gravel pene-plane which we named the "hundred-mile tennis court." It took us to a great temple on the bank of the Ongin River and eventually we reached the Sair Usu trail without incident. For the first time we felt that we were really bound for home.

Two days later we saw the ruins of a half-dozen mud houses and a small temple in a sandy basin.

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Such was Sair Usu. A little to one side of the well stood the blue tent of our caravan and the long line of boxes with Old Glory in the centre. Merin and his Mongols welcomed us joyously; the day was September 5 and we had kept our appointment.

We gave the caravan all the specimens and superfluous equipment, and told Merin to reach Kalgan not later than October 20. Actually, I may note here, he arrived ten days earlier than that date. On September 7 the rest of us started in the motors on the last leg of our journey.

That day we saw grim evidence once more that for the preceding three years a human life in Mongolia had been worth much less than that of a sheep. At one spot Shackelford and I ran over to two *yurts* to inquire about the road. Three men rode like mad to the hills and we found that only four women were left. Two were very old, one was about fifty and the fourth was a beautiful girl of eighteen or twenty. They had spread a clean white felt before the *yurt* and were lined up, trembling and kowtowing. As we stopped the car a few feet away, the girl ran to get another felt and one of the women rushed inside to bring milk and tea. In a few moments our Mongol explained that we were Americans and would not hurt them. They had never heard of America nor of any white men except Russians. When I gave them a few trinkets, they were pitifully pleased. They clung to one another, crying, and explained that they had expected to be killed in-

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stantly. They had wanted to run away but the men had taken all the horses, and we came so fast that they could not hide. A short time later we stopped at another *yurt*, and one of the two women had an attack of violent nausea from sheer fright.

Much of the country was desert-like in the extreme: a rolling gravel floor with only the scantiest vegetation and with hardly a trace of animal or human life. The monotony was depressing. I can well understand why many years ago Sir Francis Younghusband called the western Gobi one of the most desolate regions he had ever seen.

Two days after leaving Sair Usu we crossed a long stretch of sand and came into a basin more than a hundred miles in width. In the distance the blue line of an enormous bluff met the trail. It was much too good to pass, so the men made camp while the rest of us scattered over the exposure to search for fossils. An hour later I walked around the cliff and saw Shackelford on his knees near the top, scratching at the earth with his prospector's pick. He had found some large bones, which Granger identified as rhinoceros. Soon Berkey, who had been studying the side of the bluff intently for some time, called to me. He had traced the bed of an ancient stream, which more than two million years ago ran upon the surface.

It was easy to follow the course. We were looking at a cross-section of it and could see the successive layers of heavy gravel, small pebbles, sand and

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fine silt. Berkey showed that near the spot where Shackelford had found the rhino bones, there was an abrupt drop. Below was a heterogeneous mass of pebbles and large stones, which indicated a pool at the base of a small waterfall or rapid. An animal that died in the upper reaches of the stream very probably would be carried into the pool, sink to the bottom and be covered with silt. Berkey suggested that we dig into the bank at this point. In less than five minutes I located a jaw and directly below it a large skull. Then Granger put an abrupt stop to my excavations. Meanwhile Shackelford had discovered a beautiful rhinoceros jaw partly embedded, but in plain sight, and a set of teeth of a small artiodactyl—an even-toed hoofed animal.

We remained for three days at this great bluff, because, every time Granger began to remove a skull, he discovered another a few inches from it. I finally threatened to put him under arrest if he excavated further than just enough to remove the specimens already in sight.

The fauna was abundant, but there predominated a strange semi-aquatic rhinoceros. This was subsequently named *Cadurcotherium ardynense* by Professor Osborn. The region must have swarmed with turtles also, for we found shells of both large and small species in great abundance.

Granger spent almost every daylight hour in "the hole," as we named the fossil-pool. He even had

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his tiffin sent up to him. At first he allowed human visitors, but one after another we did something that incurred his palæontological displeasure and were ordered off the premises. Finally only our camp dog, Mushka, and the two pet crows remained to keep him company. On the second day Mushka tipped over a tray of bones and was banished. The crows behaved themselves fairly well and were most amusing; for they had an absurd way of getting their glossy black feathers so covered with flour paste that they could hardly fly. But at last one of them committed an unpardonable sin. Granger had taken out a skull that lacked only a tiny piece of bone from one side. After nearly an hour's search he discovered the missing fragment and carefully pasted it in position. The moment his back was turned one of the crows hopped on the specimen, picked off the bone and swallowed it. Granger never forgave the bird, and, after he returned to Peking, he was still berating it as he packed the skull for shipment to New York.

The night of September 12 was so warm that we could not use our fur sleeping-bags, but daylight brought rain and wind and a drop of forty degrees in temperature. Winter had returned in a few hours. The trail we followed on that bitter day led up and down low ridges and hills, which were mostly of schist and decidedly uninteresting. The camp at night was in a dry valley containing a grove of cottonwoods. We gathered a great pile of branches

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and had our first wood-fire since leaving the forest of Sain Noin Khan.

There were various kinds of bad going during the next morning, but in the afternoon we sped at thirty miles an hour over a great rolling plain. Here the geologists were thrown into a fever of excitement by coming upon a series of Carboniferous and Permian beds full of invertebrate fossils. Except for the single piece of rock picked up by Berkey near Gurbun Saikhan, this was the first evidence found in Mongolia of these extremely ancient periods in the history of the earth. It extended these strata for hundreds of miles north and west of their previously known occurrence and was a discovery of immense importance, for it fulfilled a prediction made by Professor A. W. Grabau that a great sea way had extended from the Central Asian Plateau to the Pacific Ocean in Palæozoic times.

About forty miles beyond the site of these deposits, Granger and I, who were riding together, saw a grey-white bluff a few yards to the north of the road and walked out to the exposure. The place was covered with fossil bones and after we had selected some of the best specimens from which to identify the horizon and were on our way back to the car, I noted a long bone partially buried. In five minutes it was evident that here was a complete titanotheres jaw with all the teeth in position.

The problem was whether we should leave it or spend the day or two that would be required for

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pasting and bandaging it properly. Since we decided that it was unwise to stop, Granger said he could remove one complete tooth-row, which would serve for positive identification of the specimen and for comparison of it with American titanotheres fossils. It would fall apart in a hundred pieces, no doubt, but they could be fitted together at the laboratories in Peking. The next half-hour saw an example of heroic methods in fossil dentistry. Every fibre of Granger's collector's soul rebelled against the crime he was committing upon a priceless specimen, and his groans, as he extracted each tooth, indicated as great pain as the titanotheres itself would have felt had it been alive. When the thing was done, we carefully covered the remainder of the jaw, took bearings upon its location and went on to join the rest of the men, who were impatiently awaiting us.¹

Farther along the trail we passed several other exposures that evidently were a part of the same formation. They indicated a vast region for palaeontological study. Granger was convinced that it was a western extension of the Iren Dabasu basin, on the Kalgan-Urga road, where we had found the first fossils on our way to Urga in the spring.

The next morning we had a foretaste of what I had been expecting every day. Rain and a bitter wind sent us into our heaviest clothes. Hour by

¹ This locality was named Ulu Usu or the "Well of Mountain Waters" and subsequently proved to be one of the richest deposits in all Mongolia.

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hour the weather grew colder. The rain changed first to sleet and then to snow. We lost our way a dozen times and finally had to draw up in the shelter of a dry riverbed. The snow came so thickly that we could not drive or find our way. But just as I had about decided to camp, the storm suddenly ceased. The ground was so warm still that the snow melted quickly, and again it was possible for us to see the tiny path. We camped near a half-dozen *yurts* under the lee of a great rock-spine, over which the wind howled like a charge of Mongolian demons. We ate dinner with our gloves on and then sought our sleeping-bags and felt warm for the first time that day. And yet, three days before, we had been uncomfortable in our tents because of the heat.

The remaining three hundred miles were uneventful but strenuous. The road, which had been fairly good, became steadily worse as we neared the area of Chinese cultivation and the traffic of Chinese spike-studded carts. In the valleys there were mud and ruts and on the hills there were ruts and rocks. At the Chinese village of Miao Tan, which we reached late in the afternoon of September 18, a cart was engaged to take the heavy luggage the remaining forty miles to Kalgan. It was well that we had no excess weight, for I had never known the Pass to be in worse condition. Our average speed was only four miles an hour. We had made so close an estimate on our gasoline supply that all the cars except

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Colgate's reached the compound of Andersen, Meyer & Co. We had to send a bottle of gasoline to bring that one car the last half-mile from its stopping-place just inside the city gate.

Larsen was in Kalgan and we had much to tell him. His first question was, "Did you get the wild ass you were after when we left you on the crest of the hill in the Gobi?" The first thing we asked him was how soon we could get a bath. Berkey and Morris stayed with Larsen, and the rest of us went to the British-American Tobacco Company's mess, where the doors are always open to travellers from the interior.

Each one of us had some article of adornment that he had been cherishing for the homecoming. Shackelford appeared in a wonderful blue shirt. I had a purple necktie and Colgate and Granger each produced a pair of new shoes. Yet when we came into the dining-room for tea, where a half-dozen visitors had assembled to welcome us, we felt uncomfortable! There was something almost pitiful about our efforts to be civilized once more.

We left Kalgan for Peking on September 21, exactly five months from the day on which we started for the great plateau to test our theories. We had gone with stout hearts and courage but all of us knew that it was a colossal gamble. Everything was staked on the turn of a card, but we had won.

CHAPTER X

GIANT BEASTS OF THREE MILLION YEARS AGO

BY HENRY FAIRFIELD OSBORN

THE Central Asiatic Expedition is revealing much more than a new chapter in the earth's history; it is revealing a new volume composed of many chapters, some of which belong in the Age of Man, others in the Age of Mammals, others in the still more remote Age of Reptiles. We have penetrated the homeland not only of the mammals of the world but of the reptiles, and we hope before the Expedition is concluded to be able to demonstrate that this is the homeland of the ancestors of man.

The high deserts of Mongolia reveal a former verdure and a wealth of life filled with the ancestors of the mammals and the ancestors of the most ancient reptiles, all of which will be fully and minutely described in time. The present chapter is devoted to two of the first and most brilliant discoveries made; namely, of a giant extinct rhinoceros and of the ancestral horned dinosaur.

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Three great explorers had crossed Mongolia before our party entered this field; namely, Raphael Pumpelly (1870), Ferdinand von Richthofen (1877) and V. A. Obruchev (1894-1896). None of these explorers and geologists reported extinct animals with the exception of Obruchev, who mentioned having found a few rhinoceros teeth. Our men set out with the warning, "You will find rock and sand but few fossils." Consequently it was a very great surprise when they came upon three distinct fossil-beds, including one belonging in the Age of Mammals, soon after they had passed the Mongolian frontier, at Iren Dabasu. Here, in fact, they came across the first evidence of the giant extinct rhinoceros of Central Asia and by its very size recognized its resemblance to an animal previously discovered in far-distant Baluchistan. The significance of the name *Baluchitherium* is the "wild beast (*thērion*) of Baluchistan"; for it was on the western confines of India, in the now forbidden territory of Baluchistan, that the first fossil bones of this giant rhinoceros were discovered, by C. Forster Cooper, in 1911.

Cooper, a graduate of Cambridge University, had been trained in American Museum of Natural History field-methods and was fired with ambition to restore the somewhat waning prestige of his countrymen in the fossil lore of Asia. He was fortunate in gaining admission to this partly subjugated outlier of the British Empire in India, which has been denied to our American Museum explorers during the past

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two years because of the present unrest among the native tribes of Baluchistan.

He came across a rich fossil-bed near the Bugti Hills of eastern Baluchistan, and among many other petrified treasures he unearthed three gigantic vertebræ of the neck and parts of the limb- and foot-bones of a land mammal quite unprecedented in size, which he named *Baluchitherium* in reference to its native country, with the specific terminal *osborni* in honor of the present writer. Between 1911 and 1923 he wrote preliminary descriptions of this animal, recognizing it from the first as new to science, and finally in a recent paper he wrote:

“*Baluchitherium* may then be described as belonging at the end of a series of odd-toed, hoofed animals remotely related to the tapirs, horses and rhinoceroses, with closest affinity to the latter family; distinguished by its long and massive neck and by its tall and relatively narrow feet; closer of kin to the rhinoceroses than to either the horses or the tapirs, but unknown either in its past history or in its descendants.”

In the meantime the Russian geologist, A. Boris-
siak, not knowing of Forster Cooper's discovery, came across an animal of similarly astounding size in Turgai, a province of northern Turkestan, which he described during the years 1915-1917 and named *Indricotherium asiaticum*. The generic name has reference to a monster called the “Indrik beast”

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occurring in an old Russian legend, "The Tale of the Dove," of the thirteenth or fourteenth century. The Indrik beast could walk, run and fly above the clouds; when he walked, the earth trembled.

A little more fortunate than Cooper, Borissiak found additional parts of both the fore and hind limbs, which were of almost exactly the same length as in Cooper's animal from Baluchistan. He also found parts of the teeth, which positively confirmed Cooper's suspicion that this was a member of the rhinoceros family. There are rumors that he found even other parts, including remains of the skull, which he has been unable to publish, owing to the depleted condition of the scientific resources of his country at the present moment. If this is true, it renders our discovery of a complete skull all the more timely, and the fact that we have been able to hurry this skull around the world for immediate restoration and description all the more fortunate.

Our Central Asiatic Expedition first ran across the remains of this extraordinary animal at Iren Dabasu in southeastern Mongolia, finding only the foot-bones and other fragments of the skeleton. This was on the journey north toward Urga. The second and most important find, namely of the skull described in this article, was made on August 5, 1922, northeast of the Altai Mountains, near Loh in the Tsagan Nor basin, in beds which have been named the Hsanda Gol. The exhumation and transportation of this skull is a little romance in itself.

It presents us with a concrete example of how long it takes to bring a wonderful new fact of nature from the other side of the globe and put it within the reach and understanding of the vision and mind of the people in the city of New York.

It took several days to work the skull out of the earth. It was transported across the desert of Mongolia and reached Peking on October 20, 1922. It reached the American Museum on December 19, 1922—a red-letter day in the Department of Vertebrate Palæontology, which received it. The scientific preparation began immediately and continued unremittingly in the hands of two, three and sometimes four preparators, until its completion on April 6, 1923. It was then ready to be reproduced a thousand-fold in still photographs and by the moving-pictures of Mr. Shackelford, and thus distributed in this country and all over the world.

The *Baluchitherium* was placed in a large case near the centre of the American Museum, with a map showing its long journey and a label giving its history, together with a complete restoration showing how it appeared in life. Within nine months of its discovery this animal was known to millions of people! This is not quite so rapid as Jules Verne's *Tour of the World in Eighty Days*, but the record is a good one when one considers the very difficult scientific problems involved, the years of experience and training necessary rightly to interpret this animal, and the faultless restoration of this skull, which ar-

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rived at the Museum in three hundred and sixty pieces of fossil bone.

Our first estimate of the height of the animal was that it stood between eleven and twelve feet at the shoulders, or one foot higher than the tallest of the living elephants of Africa, the largest existing quadrupeds. It is our agreeable duty to announce that this first estimate was under rather than over the truth. The *Baluchitherium* certainly stood over thirteen feet at the shoulders, and in reaching up for food his head may have attained a height of between seventeen and eighteen feet above the ground. This compares favorably with the reach of a tall giraffe while browsing on the uppermost leaves of the African mimosa. The giraffe rises to over seventeen feet and according to some observers to twenty feet. The head of the giraffe is small and delicate while the neck is proverbially long and slender. The neck of the *Baluchitherium* was of relatively the same length as in the horse; it did not by any means attain the long-drawn-out proportions of the neck of the giraffe.

The head of the *Baluchitherium* was of enormous size and weight, yet relatively small when compared with the height and bulk of the animal as a whole, as shown in the accompanying restorations. Two great tusks which terminate the head may have served the animal as offensive and defensive weapons, also as a means of hooking down high branches of trees in order to consume the leaves. We know

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that the African elephants, which are chiefly browsing animals, pull down the high branches of the trees by means of the proboscis; where they cannot reach them in this way, they throw their immense weight against the tree and bring it to earth, thus felling a tree from six to twelve inches in diameter.

Another reason for regarding the *Baluchitherium* as a tree-browser is the structure of the grinding teeth, which are short and broad, with sharp cutting-edges like those of the browsing rhinoceroses still living in the forests of eastern India and of Sumatra. The teeth are in very wide contrast to those of the great rhinoceroses of Africa and India, which are fond of grazing and which adopt principally the grazing habit. A third reason for regarding the *Baluchitherium* as a tree-browser is the great elevation of the fore limb and shoulder. These bones have exactly the same height as in the largest existing African elephant, but the *Baluchitherium* differs widely from the elephant in the possession of tall, stilted feet.

These tall feet, far exceeding in relative height those of any other member of the rhinoceros family, raise the shoulder of this remarkable animal two feet above the shoulder-level of the living African elephant, which seldom exceeds eleven feet, four inches. This elevation had a meaning: it carried the head aloft like a watch-tower so that the *Baluchitherium* could see its enemies approaching from a distance and thus either escape or stand at bay,

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defended by its strong tusks. The other browsing rhinoceroses, especially the "black" rhinoceroses of Africa, carry their heads close to the ground within easy reach of the shrubs and bushes on which they browse.

The very wide contrast in size and in proportions, in the length of the neck, in the height of the limbs and in the smoothness of the top of the head, between the *Baluchitherium* and all other rhinoceroses, living or extinct, is shown in the accompanying outline drawing, in which the *Baluchitherium* towers above its relative in the rhinoceros family. The nearest approach to the baluchithere is the elasmothere, an extinct single-horned rhinoceros of Siberia, which we have hitherto regarded as the largest member of its family. The giant two-horned "white" rhinoceros of Africa is silhouetted from a magnificent specimen now mounted in the American Museum; as shown in the first restoration, it appears like an infant when placed beneath the elevated head and neck of the *Baluchitherium*. The Indian rhinoceros is invaluable for comparison, because it has always been a more familiar object in natural history, and it would also appear like an infant offspring were it not for the powerful horns which point to its adult age.

The greatest anomaly in the *Baluchitherium* skull is that in the original sense of the word rhinoceros (derived from the Greek, *rhino*, nose, and *keras*, horn) it is not a rhinoceros at all. The top of the

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skull is perfectly smooth polished bone, beautifully arched, with very long, slender nasal bones absolutely devoid of any rugosity upon which a horn might be fastened. The absence of horns, which are the sole defensive weapons in the "white" and the "black" rhinoceroses of Africa, and in the single-horned rhinoceros of India, is amply compensated for by very powerful tusks. These are totally unlike the tusks of any other rhinoceros, living or fossil, and enable us to pronounce the *Baluchitherium* as representing a new branch of the rhinoceros family which may be popularly known as the baluchitheres.

These baluchitheres ranged from eastern Mongolia westward into Turkestan, southward into Baluchistan. This was their minimum range; the maximum range was probably very much greater. It would appear that they were the giant quadrupeds of the roof of the world in Miocene times, in the very mid period of the Age of Mammals.

It seems that in every one of the five geologic stages into which the Age of Mammals is divided, namely the Eocene, Oligocene, Miocene, Pliocene and Pleistocene, as if by a law ruling the mammalian world, there was one and only one quadruped dominating all others in size; such dominance we may safely assign to the baluchitheres of the heart of Asia during Miocene times. We know that the horses of the corresponding period barely reached up to the wrist of these animals; that the mastodonts and other ancestors of the elephant family barely

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reached to the level of the chest-bone. It is not at all probable that during the five years' field-work of the Central Asiatic Expedition we shall find any mammal comparable in size to the *Baluchitherium*. Its reign in Miocene times will in all probability be unchallenged.

With the *Baluchitherium* there lived a much smaller rhinoceros of normal size, an indication that this was a good rhinoceros country, like the region inhabited by the "black" and the "white" rhinoceros in the uplands of Africa today. We cannot as yet fully picture the climate and vegetation of central Mongolia as it was in *Baluchitherium* times, but we shall probably be able to do so from the rich beds of fossil plants and fossil insects which our parties are discovering, also from the other extinct animals that have already been found but have not yet reached the American Museum for examination. The teeth and the feet of the quadrupeds will also tell the story of the climate and vegetation.

The feet of the *Baluchitherium* indicate a rather resistant soil, certainly not anything of a swampy nature. They are widely different from the broad, padded feet of the elephant or even from the broad, spreading feet of the living rhinoceroses. They terminate in relatively narrow and closely compressed hoofs like those of some of the three-toed horses. This is an indication that over the entire homeland of the *Baluchitherium* the climate was south-temperate, not tropical; the country was open, not

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densely forested; the footing was fairly resistant, not soft and yielding.

A country of this kind, which is gradually passing from a stage of luxuriant vegetation and moisture into a more arid stage, lends itself to the development of a plains and savanna fauna. We anticipate finding a great variety of quadrupeds, prominent in the midst of which will be small ancestors of the three-toed horses known as *Hipparions*, swift, desert-loving equines which spread from this Central Asiatic home westward into Europe and eastward into North America. We also shall find ancestors of the true elephants, at first greatly inferior in size to the baluchitheres, but finally superseding them as the monarchs of the country. In the forests we shall find insectivores, bats and numerous rodents; and on the border-line between the forests and the savannas we may look for the *Primates*, discovering among them, we hope, some of the anthropoid apes related to the human ancestral stem.

The fertility of Central Asia during the Age of Mammals and especially during Upper Oligocene time, when the giant rhinoceroses just described roamed over this country, made this by far the most genial and attractive centre of life on the earth. It was a veritable Garden of Eden. It was probably not many thousand feet above sea-level—a plateau country with low gradients traversed by meandering river-courses. Very similar conditions also prevailed in the Rocky Mountain region in Oligocene time,

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because exactly the same types of quadrupeds inhabited both countries. Among animals, as among men, conditions of free migration and partly open country are far more favorable to evolution than either a densely forested condition or the desert condition of the present time.

The geologists of the Central Asiatic Expedition have demonstrated that these favorable conditions to varied animal life in Central Asia were of tremendously long duration, probably beyond our powers of imagination even to conceive. The explanation goes very far back into the middle period of the Age of Reptiles, when one of the most important events in the life history of the earth took place; namely, when Central Asia emerged from the sea-level and became a continent which has endured to the present day.

The Rocky Mountain region of North America and the whole region of western Europe were still at or near sea-level, subject to repeated subsidence and emergence. In other words, while Central Asia became a continent and a very important centre of reptilian evolution, western Europe and western North America were still struggling with the sea. This momentous change in the earth's history occurred in Asia at the close of Jurassic time in the very midst of the long Age of Reptiles. Whereas in western North America and western Europe, the marine *Reptilia* continued to flourish in the bays and estuaries of the hardly emerged lands, in Central Asia new types of land *Reptilia* began to evolve.

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There can be no question, from our discoveries already made, that Central Asia was the chief theatre of evolution, not only of the land *Mammalia*, but of the giant land *Reptilia* of the world. This land evolution took place chiefly among those reptiles which, from their great size, are known as dinosaurs or giant saurians, and this reptilian society soon divided into two chief classes.

This two-fold division of land dinosaur life started in a very modest way in the ancient continent which now makes the roof of the world. Defensive herbivorous types were of relatively small size and their defensive horns or armature were not very well developed. Similarly the offensive, flesh-eating types were of moderate size and power, capable of capturing all the small, herbivorous prey. Step by step, like the evolution of the modern armored battle-ship and the long-range, high-powered projectile, the herbivorous dinosaurs became larger and more stoutly defended, while their carnivorous enemies became more powerful and diversified.

Both in western North America and in western Europe, we witness the culminating stages of this remarkable offensive and defensive reptilian evolution. We are at or very near to the climax of the Age of Reptiles, when the powers of offense and defense had reached the very summit. Such a picture of offense and defense is shown in the accompanying restoration of a scene in Montana at the very close of the Age of Reptiles. At the right is a group of

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herbivorous dinosaurs, known as *Triceratops* because each skull is protected by three sharply pointed horns. These dinosaurs have their heads lowered and are preparing for a charge from the animal in the left foreground, a gigantic carnivorous reptile known as *Tyrannosaurus rex*, or "king of the tyrant saurians." This tyrannosaurus was the most terrible engine of destruction which the earth has ever seen; it is improbable that we shall ever find an animal which surpasses him. Nevertheless he is represented as contemplating whether an onslaught on the phalanx of herbivorous dinosaurs will really pay, or whether he may not be impaled on those long and sharply pointed horns!

This picture illustrates the universal principle in nature that the offensive and defensive powers in animals are always evenly balanced, and this even balance is brought about through a very long and slow process of offensive and defensive evolution.

The second and, from the purely scientific standpoint, the most brilliant discovery by the Central Asiatic Expedition was the skull of a small herbivorous land reptile which has been named *Protoceratops*, signifying the "first horned dinosaur," because after prolonged study it was recognized as the long-sought ancestor of the *Triceratops*. It is of relatively diminutive size; it has a smooth head without horns; yet we find in the structure of the teeth and of the jaw and in the general shape of the head unmistakable proofs of such ancestral relationship. This re-

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lationship has been worked out with great care by Dr. William King Gregory of the American Museum and of Columbia.

This little fossil dinosaur came from beds of much more ancient geologic age in the western part of Mongolia. It was discovered on September 2, 1922, in exposures of red shale formation east of Artsa Bogdo, near one of the old caravan trails. The age of this formation is probably Lower Cretaceous or even Upper Jurassic; by reasonable estimate of geologic time it is two or three million years older than the age of the three-horned dinosaurs occurring in Montana. Whereas the largest of the three-horned dinosaurs are gigantic animals with skulls sometimes attaining a length of eight feet and with two formidably developed horns, the little skull of western Mongolia is entirely hornless and barely attains eight inches in length. The hornless dinosaur is thus only one-twelfth the size of its great Montana descendant.

In allusion to its very primitive character, *Protoceratops* is assigned its name, signifying "the most primitive of the ceratopsians." The full name is *Protoceratops andrewsi*, the species being dedicated to Mr. Roy Chapman Andrews, in recognition of his splendid qualities as organizer and leader of the Central Asiatic Expedition. It represents a new species, a new genus, a new family, and possibly a new suborder of reptiles. Thus from the scientific standpoint the discovery of this diminutive reptile

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is even more epoch-making than that of the *Baluchitherium*. The manner in which Dr. William King Gregory determined that the *Protoceratops* was a real ancestor of the great *Triceratops* is a long story in itself. The absence of horns presents little difficulty because all very primitive reptiles as well as mammals are without horns; horns evolve especially in herbivorous animals, whether mammalian or reptilian, as a means of defense against their carnivorous enemies.

The discovery of the *Baluchitherium* skull has a very important bearing on the general theory of evolution, which is now being so widely discussed; it has an indirect bearing even on the problem of the evolution of man. Consider first the *Baluchitherium* skull as another striking example of evolution unchecked by environment, uncontrolled by enemies more powerful or more cunning than the *Baluchitherium* itself, speeding on rapidly to a great climax in a certain given direction. Such a group of animals in a favorable environment, like a group of men in a favorable environment and a favorable civilization, always increase in number with surprising rapidity, and increase in size when it is an advantage and not a disadvantage. In the *Baluchitherium* mere size counted for a great deal, enabled the animal to ward off or frighten off all the enemies of the period; it also enabled the animal to browse from the sides and tops of the trees not reached by any other browsers. This new source of food supply

was practically unlimited. As to mere size, it is certainly the largest land mammal which has ever existed with the possible exception of some of the imperial members of the elephant family.

The *Baluchitherium* appeared at a relatively early point in geologic time in the Age of Mammals, namely, the Oligocene, and we do not know how long its reign endured. It is probable, from comparison with other gigantic reptiles and mammals which have appeared from time to time on the earth, that its very size, while affording temporary advantage, became in the end the cause of its extinction.

In general, it is the highly specialized animals, like the *Baluchitherium*, which disappear, while the more simple and generalized animals survive and become in turn the specialized forms of a succeeding geologic epoch. There are, however, so many and such varied causes of extinction that we must await evidence from the forthcoming work of the Expedition before we can answer the interesting question when and why this gigantic animal became extinct.

As for the *Baluchitherium* in its bearing on our search for man, the discovery of the skull and our consequent knowledge of the character of the country—the roof of the world—during this period, is favorable to the supposition *that the ancestors of man may also be found in the same country*, because we are now convinced that our human ancestors branched

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off from the other anthropoid-ape stock in Oligocene time, the very period when the *Baluchitherium* was flourishing. We are also convinced that these ancestors were not living in a densely forested country, but in partly open country where progression on the hind limbs is more favorable than progression on all fours, of the quadrupedal type, or progression in trees, of the aboreal type.

In other words, the *Baluchitherium* was probably contemporary with our remote ancestors about the time that they were beginning to lead an independent existence and to move about in an erect or semi-erect position. The writer two years ago expressed his conviction that one of the most surprising discoveries yet to be made in the history of science would be the discovery in the midst of the Age of Mammals of a relatively large-brained, erect-walking ancestral type of man. This discovery will most probably be made in Asia; it would be rash to predict that it will be made in that part of Asia where our parties are now working, but in our opinion it is more probable that we are relatively near the centre of human origin, because the *Baluchitherium* reveals the kind of country in which we should expect to find our ancestors in this earliest stage of development.

These two discoveries—the *Baluchitherium* and the *Protoceratops*—as briefly and popularly set forth, represent the opening of a new volume in the history of the roof of the world.

CHAPTER XI

NEW WORK AND DISCOVERIES

THE winter of 1922-1923 I spent in Peking preparing for the next summer's expedition. Granger again visited the fossil fields in Szechuan on the Yangtze River while others of the party returned to New York to begin scientific work upon the collections.

Since the first expedition to Mongolia had been largely one of reconnaissance, it was necessary to investigate more fully the fossil beds already located if we were to reap the results of our initial work. With this end in view, three new expert palæontological collectors were added to the staff. They were Messrs. George Olsen, Peter Kaison and Albert Johnson. Since Mr. Colgate could not return, the motor transportation was put in charge of Messrs. Mackenzie Young and C. Vance Johnson. Both of these men had lived with cars all of their lives and were competent to repair any breakage which might result from the terrible punishment which we knew the motors would have to undergo.

The expedition left Peking on April 17, the date

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of our first departure the year before, and started from Kalgan on April 20. For a month there had been an unprecedented number of robberies along the caravan trail within the area of Chinese cultivation which extends for one hundred miles beyond Kalgan. The week before we left two Russian cars had been stripped of a valuable cargo of furs and one man killed. Several caravans had been held up within a few miles of Kalgan and the Chinese authorities manifested considerable anxiety about the safety of our expedition.

As usual we spent the first night at the little Chinese inn of Miao Tan only thirty-four miles from Kalgan, for I had no wish to camp in the brigand infested hills.

Just before we left in the morning the commander of a company of soldiers who were quartered in the village called upon me and said that he had been directed to send a guard in advance to insure our safety.

He naïvely remarked, "Please be careful not to shoot my soldiers."

I was much amused at his fear that we might not be able to distinguish brigands from soldiers. As a matter of fact they are virtually synonymous in many parts of China.

About five miles down the road we overtook the soldiers who, when they saw us approaching, promptly displayed a Chinese flag and announced our arrival by bugle calls.

We had confidently expected to find our caravan awaiting us at Iren Dabasu, where we were to do our first work, but it was not there. I knew that Merin had taken a trail east of the main road because it was safer and offered better grazing for the camels; yet Mongols who had travelled by the same way reported no sign of our caravan. It was easily identifiable, for the boxes were peculiar in shape and the big camel in the lead always bore the American flag. We began to be greatly worried, especially a week later, when Granger and Morris drove seventy miles down the trail without discovering our camels.

We feared that they had been captured and driven off into the desert; for brigands were numerous in that region. Though the food that the boxes contained would be of little interest to the bandits, the camels themselves could be disposed of easily enough, and the three thousand gallons of gasoline sold in small lots to the motor-stations along the main road. It would be a crushing blow to the expedition, if we lost our caravan at the beginning of the season. I made up my mind that if it was not heard from soon I would take three or four of our men who were simply spoiling for a fight, follow the caravan on horseback from the point where Merin had last been seen, and recapture it.

But canny old Merin had not been caught after all, and one evening a car roared into camp with the word that our camels were twenty miles away

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at the *Lung-Ku-Shan*, "Dragon-bone Hill," and would get in next day. The Mongols arrived as gleeful as children to be safe in camp with us. Merin said that, on hearing that there were bandits ahead of him, watching the trail, he slipped off into the desert. Thereafter he travelled at night from well to well and camped during the day in sheltered hollows, where he could not easily be seen. His weather-tanned face simply beamed as he told how he had played hide-and-seek with the brigands and yet had filled the stomachs of his camels with some of the best grazing they had had all winter.

It was at Iren Dabasu that we had made our first great discovery of dinosaurs and strata of the Age of Reptiles in 1922. We had spent only ten days there at that time and now we wished to make a more careful study of this rich locality.

The morning after our arrival the three new men, Kaison, Olsen and Johnson, set out eagerly with picks and collecting-sacks to have their initial experience in the fossil-fields of Mongolia. Morris, Granger, Young and I drove westward on a trip of exploration for additional exposures that would be likely to harbor fossils.

Eight miles from camp we saw the familiar grey-white strata and stopped to prospect. Almost immediately we found teeth and fragments of bone scattered over the surface in a half-dozen places. Granger discovered a huge femur half exposed by the action of wind and rain and frost, which were

wearing away the rock particle by particle. As I walked slowly over the ridge that day, I had such feelings as I suppose inspire every prospector for gold. It was a likely-looking place, and at any moment a discoloration in the rock or a tiny fragment of bone might give the clue to a mine of palæontological wealth. Without a doubt there were hundreds of bones lying just beneath the surface. But where? If only my eyes could pierce that baffling surface and get a glimpse of what lay concealed!

It is well-nigh hopeless to dig for fossils unless there are definite indications of their presence. There must be some clue, a piece of bone "running in" or something upon which to fasten hope. Otherwise one might dig and dig and miss the greatest treasures by a few feet or even inches. Of course, one finds many bones broken by weathering into a hundred fragments and not connected with other parts of the skeleton beneath the surface. Disappointments come most frequently in fossils deposited in an old stream-bed, where swift water has rolled and broken them before they could be buried in sediment and preserved. I know one such deposit where remains of *Baluchitherium* are abundant in gravel. Time after time I have felt my blood thrill with excitement at sight of a projecting bone. But after the rock or earth had been carefully worked away, only a useless fragment would be uncovered!

My feelings about all such stream deposits are a

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standing joke with the Expedition. I am hardly philosophical enough for a palæontological collector. Disappointments and successes send me too easily into the blackest depths or to the pinnacle of happiness, and particularly I cannot curb my impatience sufficiently when a specimen has been found. Walter Granger or any of the other trained men are content to work away the matrix around a fossil with a camel's-hair brush, grain by grain, waiting for the specimen to develop as they go down. Theirs is admittedly the proper way to proceed, but pick-and-shovel methods, which at least give quick results, are suited naturally to my restless spirit. Perhaps a complete skeleton or a priceless skull lies below that bit of projecting bone, and I simply cannot wait for days to know. Therefore, whenever one of the men is engaged upon the delicate operation of removing a specimen, the chief palæontologist issues an ultimatum to the leader of the Expedition: "Thou shalt not approach this sacred spot unless thy pick is left behind."

In our brief survey of the Cretaceous ridge west of Iren Dabasu, we saw enough to warrant sending over three men for a careful inspection. Each one of them immediately discovered important fossils deposited in what proved to be "quarries." Albert Johnson's was the richest. His keen eyes were attracted by a fragment of bone not more than three inches long. By following out this clue, he gradually exposed so great a deposit that for a month he and

Kaison worked continually in a single spot. The fossils lay only a foot or two below the surface, but were so completely covered that, except for the three inch bit which gave away the secret, their presence would have been unsuspected.

In this deposit bones of both flesh-eating and herbivorous dinosaurs, of many individuals and of several species, were piled one upon the other in a heterogeneous mass. Their look of having been subjected to a swirling action when they were deposited, led us to believe that this spot had been a backwater or eddy at the edge of a lake. When the dinosaurs died, their bodies drifted into this bayou and came to rest. Then the flesh decomposed and the skeletons sank into the soft mud and eventually were fossilized. On the shores of the lake five million years ago there must have grown a lush vegetation; for many of the bones were those of dinosaurs of the duckbill or iguanodont type, which wallowed in the mud along the edges of lakes or streams where the water-plants were soft and succulent. These great dinosaurs, thirty-five or forty feet in length, walked on their hind legs and, like the kangaroos of today, were short and weak in their fore limbs. They had an enormous number of teeth—four hundred in each jaw. New layers came into use as the upper rows wore down, and thus a broad grinding-surface was produced. Since dinosaurs of this type were herbivorous feeders and without means of defense, they must have proved an easy prey to the

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great carnivorous dinosaurs, which were contemporaneous. We found some bones of the carnivores mixed with those of the herb-eaters. In the midst of battle, very probably, the fierce, flesh-eating reptiles had been drawn into the deep waters of the lake and drowned, so that their skeletons were fossilized with those of their victims.

The number of creatures that swarmed in this region during the Age of Reptiles, baffles the imagination. It must have been a nightmare country, filled with goblin-like animals, stranger even than those born of delirium. Today, this nightmare world of the past is gone. In its place lie the silent, wind-swept dunes of the Gobi Desert, parched and blistering under the summer's sun and in the winter, an area of arctic desolation. The alkali shores of a dry, sun-burned marsh mark a corner of the great lake, the waters of which once lapped the edges of the ridge upon which we stood. As far as my eye could reach were hummocks of wind-blown sand, crowned by thorny desert plants.

In the "quarry" that Johnson opened, he found bones in a cross section excavation; perhaps he would uncover the end of a limb, only to find that it ran beneath another bone, which must be removed before the first could be prepared. It was like a game of jackstraws, and only men with years of experience and infinite patience could have done the work at all. Some specimens were so closely cemented together that they could not be separated in the field,

and large blocks of bones and matrix were removed entire. Even the most fragile of Tut-ankh-Amen's burial furniture was not handled or packed with greater care than were these specimens from the Gobi Desert, so many millions of years older than those from the Valley of the Kings' Tombs.

Instead of remaining a few days at Iren Dabasu, we stayed a month, and, while operations were proceeding, Vance Johnson and I drove to Kalgan with two cars to bring up additional supplies. On the way I had an amusing experience with brigands.

I was more than a mile in advance of Johnson as we approached the place where the two Russian cars had been robbed a few weeks earlier. As I recognized the spot the thought came to me, "I wonder if brigands would attempt to hold me up on the same ground." Almost at the same moment, I saw the flash of a gun-barrel on the summit of a hill three hundred yards away. The head and shoulders of a single mounted horseman were just visible against the sky. In Mongolia and China only two kinds of natives have modern rifles—brigands and soldiers. As a matter of fact, these terms are virtually synonymous. The horseman on the hilltop was doubtless a sentinel to give warning to others in the valley below. I had no mind to have him in such a position, whoever he might be, and, drawing my revolver, I fired twice. The bullets must have come too close for comfort, although I did not attempt to hit him, for he instantly disappeared.

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A moment later, as the car topped the rim of the valley, I saw three mounted bandits at the bottom of the slope. It would have been impossible to turn the car and retreat without exposing myself to close-range shots and knowing that a Mongol pony never would stand against the charge of a motor I decided to attack. The cut-out was open and with a smooth stretch in front of me, I roared down the slope at forty miles an hour. The expected happened! While the brigands were endeavoring to unship their rifles, which were on their backs, their horses began a series of leaps and bounds, madly bucking and rearing, so that the men could hardly stay in their saddles. I opened up with one of my six-shooters, firing close to their heads, and in a second the situation had changed! The only thing that the brigands wanted to do was to get away. When last I saw them, they were breaking all speed-records on the other side of the valley. It would have been easy to kill them all, but I did not wish to shoot them in cold blood, and contented myself with giving them the worst fright of their lives.

When we returned to camp I brought with me Colonel H. Dunlap, Commander of the U. S. Marine Corps Detachment of the American Legation, Peking, and Lieut. Col. Seth Williams who spent a week with the expedition. None of us will forget the days with these two delightful officers who shot antelope and sand-grouse and watched the excavation of fossils with the keenest interest. When they returned

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to Peking our last contact was severed with the outside world for many months. A few days after their departure we started westward for Camp Titan at Ulu Usu, the "Well of the Mountain Waters."

"Camp Titan: situated at the junction of Hell with the Sair Usu trail. A cemetery of titanotheres, rhinoceroses and new beasts. Overlaid with loose sand." Such is the entry in my journal on June 14, 1923, the date of our arrival.

The next afternoon, while I was making the round of the diggings, the strong wind that had been blowing all the morning increased to a full gale. The basin seemed to be smoking like the crater of a volcano. Yellow "wind-devil" clouds eddied up from the floor and swirled across the plain. To the north an ominous tawny bank advanced upon us at race-horse speed.

I started into the valley to recall the men, but almost instantly a thousand shrieking storm-demons were pelting my face with sand and gravel. Breathing was difficult; seeing impossible. I stumbled over the rim of the basin, back to the plain, and tried to strike diagonally toward camp. It was like pushing into a fantastic yellow wall, which gave and closed behind me as I advanced. Even the ground beneath my feet was invisible. In a few moments I realized that I was being carried far to the east of the tents. The only recourse was a turn into the wind until I could find the rim of the valley again and crawl along it to the cut behind camp. With head com-

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pletely enveloped in my coat, I fought the salvos of sand and gravel. In perhaps ten minutes, perhaps a half-hour, I stumbled into a depression and, huddled against the wind, lay there trying to think.

Suddenly forms took shape in the smother right beside me. I reached out and caught one of them by the leg. It proved to be our Mongol, Tserin, and with him was Peter Kaison. Pressing our mouths close against one another's ears we held a consultation. Tserin thought the tents were directly south of us; Peter and I had no idea where they were. I decided to trust the native's instinct.

So clinging together we groped our way through the blinding murk. At last we stumbled over a black object. It was the cook-tent, still standing but at every blast in danger of being torn in shreds. The mess-tent was just beside it. We found our way inside and lay on the ground with our faces buried in wet cloths; it was the only way in which we could breathe.

One by one the men blew into camp, with the exception of Walter Granger. It was impossible to search for him, and I was not greatly worried, since Granger had demonstrated many times his ability to take care of himself. But our Chinese boy, "Buckshot," who worships Granger, was so frantic with anxiety that, if I had not forbidden him to leave camp, he would have dashed wildly into the blasts of sand to look for his master. We were helpless and as Albert Johnson remarked, "The directions

say, 'Take it!'" And we took it in whatever position we found most comfortable.

The gale continued for an hour and then dropped suddenly into a flat calm. Not a breath stirred the flag, which hung limply above my tent, whipped almost to ribbons. The silence was uncanny after the roar and rush of the storm.

Just as we were crawling out of the mess-tent, we heard a joyous shout from "Buckshot" and saw a brown figure coming into camp. Behind the broad grin on the desert-colored face was Walter Granger. When the storm broke, he had fought his way to a partly excavated titanotherium skull, to mark the spot for fear it would be lost in the shifting sand. He reached it but could go no farther and huddled into the pit with his face in a coat. He had been completely buried, except for his head, and well-nigh smothered.

We began to dig out the tents and empty the sand from our clothes and beds. Half the Gobi Desert seemed to be in our belongings and it had sifted into the tightest boxes. The cameras, rifles, pistols and field-glasses had suffered most, for even their double cases could not keep them clean. We worked steadily for two hours at "shovelling out." I sent a car to the well of the "Mountain Waters," a mile away, and everyone had a bath and dressed in clean clothes. We felt human once more.

But while dinner was being served, one of the men looked toward the north and gave a shout. There

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it was again—the same tawny cloud! This time it was preceded by an enormous “wind-devil,” which danced wildly across the plain. It was heading toward us, and we knew what to expect if it struck our camp. I called for all hands to weight the bottoms of the tents and pound in the pegs. Explosions of wrath were heard from every side because there we were so clean then and knew full well how dirty we should be in a moment.

The attack came with a crash and a blast of gravel like exploding shrapnel. For five minutes the sand-spout whirled round the camp as if trying to suck the tents and all our belongings into the vortex above our heads. Then, repulsed at every point, it danced away across the plain and vanished presently in the distance.

Granger and I had held our tent down together, and in the calm after the first attack we looked at each other and burst out laughing. “Great gods! Am I as dirty as you are?” he asked. But when he had looked at himself in a mirror he grunted disgustedly: “This finishes it. The Mongols have the right idea; no more baths for me. What’s the use? I’m going to bed.”

Right he was; for the wind began again and developed into a full gale before the hour had passed. For ten days it blew continuously, and never was there enough calm to make it worth while to clean up.

Ulu Usu proved to be one of the most important

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localities for fossil collecting that we discovered in all Mongolia. The remains of titanotheres were there in great abundance. These great beasts superficially resembled rhinoceroses but were more closely related to the tapirs. They reached their greatest development and became extinct three or four million years ago in the middle period of the Age of Mammals. Their discovery in Mongolia was the fulfillment of a brilliant prediction made by Prof. Osborn many years ago. For two decades he had been studying these extraordinary animals and preparing a monumental monograph on their evolution. Although titanotheres had been found only in America, with the possible exception of a doubtful fragment from Austria, Prof. Osborn believed that originally they had been migrants from Central Asia. When we went into the field in 1922 he instructed us to watch particularly for the remains of titanotheres. Almost immediately his prophecy was fulfilled, for in the Valley of the Jewels near Iren Dabasu we found the first titanotheres known in Asia.

We considered ourselves particularly fortunate in discovering two or three beautiful skulls there, but Ulu Usu proved to be a veritable titanotheres mine. In the sandy basin which had been eroded out of the great sedimentary plain, fossil bones were strewn over the surface almost as thickly as stones. Every man of the expedition discovered titanotheres remains within a few days and Granger suggested publishing

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an expedition newspaper with the title of "The Daily Skull."

Two weeks of work yielded fourteen titanotheres skulls of several species, besides a complete skeleton of a long-legged rhinoceros and many other smaller animals. It was at first supposed that this formation was a continuation of the Irдин Manha in the Valley of the Jewels, but the titanotheres demonstrated conclusively that it is quite distinct and represents a later phase of the upper Eocene.

We might have spent several profitable weeks at the Well of the Mountain Waters, but in our plan for the season's work only a fortnight had been allotted to this locality. However, before we left for the Flaming Cliffs more than a ton of valuable specimens were deposited in a nearby temple to be taken by the camels on their return journey to Kalgan.

CHAPTER XII

WHERE THE DINOSAUR HID ITS EGGS

WE went to the Flaming Cliffs through the desolation of a sun-parched desert from the "Mountain Waters Camp," four hundred miles to the east. For a year there had been no rain. We followed the tracks of our own motor-cars made ten months before. The scanty vegetation lay brown and shrivelled by the pitiless sun; white rims of alkali marked the beds of former ponds; the desert swam in a maddening, dancing mirage that mirrored reedy lakes and cool, forested islets where we knew there was only sand.

We had travelled mile after mile without seeing a living thing save scurrying spotted lizards and the long-tailed gazelles that do not need to drink. The way was marked by the skeletons of camels and the bones of sheep. The few Mongols with whom we had talked before entering the desert told us that their friends had moved away from this area of desolation; discouraged by the death of scores of horses, sheep and camels, they had gone to the north in search of better feed.

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Our caravan had been left near the "Mountain Waters Camp" with instructions to follow us with food and gasoline. Like all the camels of eastern Mongolia, ours had suffered from the lack of food and were woefully thin, with soft, flapping humps. But old Merin, the caravan leader, thought that they could hold out till they overtook us in the Altai Mountains, where, according to report, conditions were better. If they did not reach us, the situation would be serious. Without gasoline we should be well-nigh as helpless as Robinson Crusoe on his desert island; yet we must reach the red fossil-beds of the Flaming Cliffs at the eastern extremity of the Altai Mountains, where the ancestral dinosaur had been found the year before.

Ten million years ago, a goblin-like creature stood on the edge of a shallow basin in what now is called Mongolia. Its great round eyes stared unblinkingly from a thin, hatchet face, ending in a hooked beak. Its head sloped up and back into a circular bony frill, which formed a solid armature over the neck and fore-shoulders. Low in front and high behind, with its nine-foot body ending in a thick tail, it seemed like a horrid, nightmare fantasy. Slowly it waddled down the slope and settled itself into the red sand. And there in the hollow it left twenty elliptical white eggs, fated, though warmed by the sun's rays, never to be hatched.

But it and its kind laid other eggs, which did

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hatch, and the dinosuars lived their allotted span and died. They never could know that their progeny, after hundreds of thousands of generations, would wander into Siberia, cross the land-bridge to America and spread inland from its western coast. They did not know that their offspring would become the most grotesque of creatures, that they would grow to enormous size and develop horns; that the bony frill protecting the neck would expand into a formidable shield so broad that a man scarcely could span it with his arms!

Yet these things came to pass, and, when the fossil bones of *Triceratops*, the most formidable of the three-horned dinosaurs, were found in America, no man knew whence they came. They suddenly appeared completely developed in the rocks of the upper part of the Age of Reptiles and gave no clue to their family tree.

It was on a brilliant day of midsummer, ten million years after the reptile had made its nest in the sandy hollow, that we pitched our tents on the rim of a great depression just above the spot where the eggs were laid. Since that far, dim day when they were left to be hatched by the Cretaceous sun, hundreds of feet of sediment had drifted over them and, through the action of wind, frost and rain, had been worn away again, leaving them half exposed. Some showed only as bits of broken shell, but four remained intact. They were no longer white, during their long entombment they had changed to a delicate brown.

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The dinosaur that laid the eggs never would have recognized the surroundings of the nest could it have seen them in 1923. A great depression a dozen miles in width and more than that in length had been scooped out of a plain as hard and smooth as a tennis-court, which swept in gentle undulations to the base of the Altai Mountains, thirty miles away. The plain dropped abruptly into the basin, its edge a vast complex of ravines and gullies, red battlements and rounded turrets. Sheer walls and gigantic chimneys stood isolated on the sandy floor like the ruins of a war-swept city. Among these wandered two humped camels, and sheep drifted in snow-white patches over the green reaches of a dying lake-bed.

It was a great day for the Central Asiatic Expedition when we arrived at the Flaming Cliffs. Camp was pitched about three o'clock in the afternoon. The cooks were instructed to make a dried-apple pie for dinner, and a vacation was declared for the remainder of the day. But it was impossible to keep the enthusiastic fossil-hunters from immediately exploring the fascinating basin that lay below them.

One by one they wandered down the steep bluff, and soon they all were scattered among the ravines and along the sides of the sculptured buttes. In less than an hour Albert Johnson returned, seething with excitement, to get his tool-bag and paste-pot. He reported the discovery of a large white

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skull. In a few moments Kaison hurried up the slope for his collecting materials, and, when we gathered about the dinner-table in the mess-tent that evening, every man had begun to excavate a dinosaur skull. Even I had had a share in the finds; for, while walking in the bottom of the ravine, I saw a pipe lying beside a rock. It was one that Granger had lost the year before and, strangely enough, it had dropped within a few inches of the skull and jaws of a *Protoceratops*. Granger said that he had left the pipe to mark the spot and that I had only rediscovered the skull, but I insisted upon having my name painted in red ink on the specimen after it had been removed.

Our real thrill came on the second day, when George Olsen reported at tiffin that he was sure he had found fossil eggs. We joked him a good deal, but nevertheless all of us were curious enough to walk down with him after luncheon. Then our indifference suddenly evaporated; for we realized that we were looking at the first dinosaur eggs ever seen by a human being. We could hardly believe our eyes, but, even though we tried to account for them in every possible way as geological phenomena, there was no shadow of doubt that they really were eggs. That they must be those of a dinosaur we felt certain. True enough, it never was known before that dinosaurs did lay eggs, but, since most modern reptiles are oviparous, it was considered probable that their ancient ancestors followed this method of re-

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production. Nevertheless, although hundreds of skulls and skeletons of dinosaurs had been discovered in various parts of the world, never had an egg been brought to light.

These eggs could not be those of a bird. No birds are known from the Lower Cretaceous, the geological horizon in which the eggs were found, and all the Jurassic and Upper Cretaceous birds were much too small to have laid eggs of this size. The elongate shape of the eggs is distinctly reptilian. A bird's egg usually is much larger at one end than at the other, because it is deposited in a nest, from which it might roll out unless it revolved on its point. Reptile eggs, which are deposited in shallow depressions scooped out of the sand, usually are elongate and similar in shape to the specimens that we found. These eggs were in a great deposit full of dinosaur skeletons and containing, so far as we could discover, no remains of other animals or of birds.

Three of the eggs were exposed and evidently had broken out of the sandstone ledge beside which they were lying. Other shell fragments were partially embedded in the rock. Just under the low sandstone shelf we could see the projecting ends of two more eggs. While all the members of the Expedition were on their hands and knees about those ten-million-year-old eggs, George Olsen began to scrape away the loose rock on the summit of the shelf, and to our amazement he uncovered the skeleton of a small dinosaur, lying four inches above

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the eggs. It was a toothless species and we believe that it may have been overtaken by a sand-storm in the very act of robbing the dinosaur nest. Prof. Osborn has named it *Oviraptor* (the egg seizer) *philoceratops* signifying "fondness for ceratopsian eggs."

We believe that the eggs originally were buried in fine sand, which would be peculiarly suitable for the preservation of delicate objects. The first specimens found by George Olsen are about eight inches in length and seven inches in circumference. They are rather more elongate and flattened than is usual in the case of modern reptile eggs and differ greatly in shape from the eggs of any known bird.

The preservation is beautiful. Some of the eggs have been crushed, but the pebbled surface of the shells is as perfect as if the eggs had been laid yesterday instead of ten million years ago. The shells are about one-sixteenth of an inch thick and doubtless were hard and not membranous. Fine sand has filtered through breaks, and the interior of all the eggs is solid sandstone. In the photographs, the bits of broken shell partially embedded in the rock are plainly to be seen, and it needs no stretch of imagination to realize that the objects pictured are really eggs. In fact, we tried our best to think of any geological phenomena that could have produced a similar result, but try as we would, we could never get away from the fact that "Eggs is eggs" and that these were laid by a dinosaur.

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A few days after the first discovery, five eggs were found in a cluster. Albert Johnson also obtained a group of nine. Altogether twenty-five eggs were taken out. Some of them, as in the case of the original group, were lying upon the surface of the ground, exposed by the erosion that had worn away the sandstone in which they were embedded; others were enclosed in the rock, with only the ends in sight. The eggs in Johnson's "clutch" were considerably smaller than the original lot and were unbroken. They may have been laid by a "pullet" dinosaur, and the large ones by a full-grown "hen." But more probably they are the eggs of an entirely different species.

Most interesting of all was the fact that in two eggs that had been broken in half we could plainly detect the delicate bone of the embryonic dinosaurs. Never before in the history of science has it been possible to study palæoembryology! Not only did we discover the eggs, but we obtained during our five weeks in this locality a complete developmental series of *Protoceratops*. Baby dinosaurs, which probably had been hatched only a few weeks, and others in all stages of growth up to the adults nine feet long, with completely developed frills were added to our collection. These have been placed in series, from the eggs to the adults and is an amazing exhibition of age development in a single species of dinosaur. No other spot on earth has yielded such a quantity of specimens and such unique material as this sandy

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basin in the centre of the Gobi Desert. When we looked upon the seventy-five skulls that we had taken within an area of three miles, we all decided that the Red Beds did not owe us anything.

While we were reaping this palæontological harvest, our minds were not entirely at rest. We had been able to carry in the cars just gasoline enough to take us to the Flaming Cliffs and food sufficient for a month. Merin had said that he certainly could reach us in that time with the caravan but we had seen the dismaying evidences of the terrible drought that had scourged the desert during the winter and spring.

The influx of specimens required an unusual amount of flour for use in paste, and at the end of three weeks our food was reduced virtually to tea and meat. Half a sack of flour remained, but if it were used for food, work would have to cease; for fossils are so exceedingly delicate that they cannot be removed when the rock has been chipped away, unless they are strengthened with strips of burlap or cloth soaked in flour paste. When I asked the men what they wished to do, unanimously they said, "Let's keep the flour for work." It was an excellent example of the enthusiasm and loyalty of the whole staff.

Not only was the flour nearly gone, but the burlap was used up, so that we had to substitute something else. First, we cut off all the tent-flaps; then we fell back on towels, wash-cloths and at last our clothes.

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Everyone contributed something—socks, trousers, shirts or underclothes. There is in the collection a beautiful dinosaur skull fortified with strips from my pajamas, and Frederick Morris, after considerable thought, presented one of his two pairs of trousers. That night Kaison came in very much depressed, and, when I asked him why he looked so solemn, he said: “Mr. Andrews, I can use almost anything, but I simply cannot paste with Morris’ pants.”

We knew that, even if the caravan never reached us, we should not starve; for there was plenty of meat. Thousands of antelopes were on the plains and sheep could be obtained from the natives. The Mongols live upon animal products; milk, cheese and mutton are their only food. We were afraid of milk even after it had been boiled; for the vessels in which it was collected were so filthy that dysentery and similar diseases would certainly have developed in our party had we used it very extensively. I tried to have the goats milked into some of our own pails, but they were so unlike those used by the Mongols that the animals were afraid and would give no milk at all. The cheese was even worse than the milk, and to watch the process of making it totally destroyed our appetite. The natives have developed immunity from germs; but our experience of the year before demonstrated that the use of either milk or cheese was certain to bring us disastrous results. The diet of meat was somewhat monotonous but did not cause us any real inconvenience. We ate

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fried antelope for breakfast, stewed antelope for tiffin and roast antelope for dinner. Our only discomfort was the lack of sugar. I myself use very little sugar ordinarily, but when I was deprived of it altogether, I could think of nothing else and even used to dream of it at night.

One day we discovered a caravan of Chinese traders who were on their return journey from Turkestan and Kashgar. From them we obtained a double handful of a substance that they said was sugar, but which looked more like coal. Nevertheless, since it tasted sweet, I brought it back to camp in triumph. With the black lumps in the middle of the table we debated how the treasure should be distributed. Finally it was decided to divide it into eight equal portions. After everyone had passed judgment upon the divisions and agreed that they were as nearly equal as it was possible to make them, we put corresponding numbers in a hat and drew for lots. Each man then took his share, to do with it as he pleased. When we gathered for the next meal, every one brought his packet of sugar with him as during wartime. Granger ate his all at once, but the rest of us spread our portions out for several days. Johnson decided that he would make his into sirup, but when the substance had been boiled and he saw the variety of insects, twigs and other débris that floated to the surface, he admitted that "where ignorance is bliss, 'tis folly to be wise." I preferred to take the insects in a solid state and

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made my sugar into a round ball about the size of a walnut, which I could nibble at sparingly whenever I had a cup of tea.

When our food began to get low, I sent riders out for a hundred miles to north and south, hoping to get news of our camels. They returned without information, except that the Mongols whom they encountered assured them that no large caravan had passed that way. The situation finally became so serious that I decided to send two of my picked Mongols back along the trail that the caravan probably would follow, until they either encountered it or reached the spot from which it had started. I gave them orders not to return without news of some kind. They took different routes, but at the point where the trails joined, one of the men returned, because his ponies were exhausted, and left the other to go on alone. This man, Tserin, a young fellow in whom I had the greatest confidence, rode horseback for more than a hundred miles, until he reached a point where the feed was so scanty that ponies could no longer be used. Then he obtained a camel and went on across the desert for six or seven days without seeing a human being. Finally two lama priests appeared on ponies and, coming up at full speed, attacked him with their riding-whips. He was knocked insensible and, when he recovered consciousness, found that his money and a pair of valuable field-glasses belonging to Granger had been stolen from him. Tserin was so badly injured that he lay

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ill in a temple for some time before he was able to start back to us. Several weeks later he reached our camp in very bad condition, after having ridden and walked for nearly three hundred miles. The poor fellow was heart-broken, because, since he had no money with which to hire camels and, besides, was so ill that he could barely ride, he had to return without fulfilling his mission.

One day a wizened old lama priest rode into camp. Our Mongols greeted him with the greatest reverence and told us that he was a famous astrologer, who had heard of our predicament and had come more than thirty miles to help us. They said that he would be able to tell us exactly where the caravan was. The old fellow made elaborate preparations and, after a long incantation, announced that the caravan was many days' travel away from us, but that we would hear definite news of it in three days. He said that our camels were dying and that Merin was having a very difficult time. Our Mongols believed him implicitly. As a matter of fact, we did hear news of Merin in four days, because one of my men discovered him sixty-five miles to the west of us, at Artsa Bogdo, which was the destination that I had given him. He had found it impossible to cross the sun-parched desert and had circled far to the north, where there was better feed, leaving his camels at wells along the trail, wherever they died or became so weak that they could no longer travel. Out of the seventy-five camels, sixteen came through, carry-

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ing food and gasoline and, above all, sugar! Eventually twenty-three more reached Artsa Bogdo. They had been left at a well in charge of a single Mongol and had been able to find sufficient food to give them strength to go on slowly. To celebrate the arrival of the caravan, we had a big dinner with camel sage for table decorations.

Almost immediately Olson and "Buckshot" began to pack the great pile of fossils that had accumulated in the tents. The proper care of delicate specimens for their long journey across the desert was one of the greatest problems of the Expedition; for there is no wood of any kind in the Gobi and no other packing-material than stiff grass. The food and gasoline cases provided boxes. Whenever the cars met the caravan, we took food and gasoline from the wooden boxes and substituted fossils and other collections. The packing-material was obtained from the animals themselves. The Mongolian camel grows very long wool to protect him during the bitter months of winter, and, as the weather becomes warmer, his coat falls away in strips and patches. Whenever we wanted to pack a box, we simply pulled the necessary quantity of wool off our camels. No finer packing-material could be devised, and a new crop continually appeared as the weather grew warmer and the camels shed more readily. But a certain amount of care had to be exercised in plucking the poor beasts; for a camel, in spite of his size, is a very delicate animal.

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If we removed his underclothes too suddenly, he was very likely to catch cold and to whimper in the most disconsolate way, while great tears ran out of his eyes.

The more I see of a camel, the more extraordinary he appears to me. Certainly he is not a beast of our day; he is a remnant of the Pleistocene. He will pass with a disdainful sniff the most succulent green grass and walk straight out on the desert, to lunch contentedly on thorny camel sage and other vegetation that apparently does not contain nourishment enough to keep a wooden animal alive. He cries piteously whenever he is loaded or unloaded and whenever he is asked to kneel or to rise. To see him hurrying across the plains, his legs flying in every direction always makes me think of Professor Charles P. Berkey's remark that "A camel is made up of spare parts." Nevertheless, with all his peculiarities, he is wonderfully adapted for life on the desert, and no other animal can take his place in the wilds of Mongolia.

Just before we left the camp at the red beds, Granger, Morris and I drove to the Gurbun Saikhan, "The Three Good Ones," an isolated range of the eastern Altai Mountains. It was August 10 and a day that I shall always remember because of the strange haze that hung over the desert. The year before, Berkey and Morris had explored the western end of the Gurbun Saikhan on camels but had not gone to the north or the east.

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Well over toward the mountains we had an amazing spectacle of wild life—the largest herd of antelopes I ever have seen. The entire horizon appeared to be a moving line of yellow bodies and curving necks. As we ran toward them in the car, the great herd divided into groups of bucks, does and young. Thousands upon thousands passed in front of us, sometimes stopping to gaze curiously at the car or running just fast enough to keep at what they thought was a safe distance. Nowhere else except in Africa would it be possible to see such a herd of wild animals. We estimated that at least six thousand were immediately in front of us, but there may have been twice that number, for the yellow groups stretched far beyond our sight. They were feeding upon the rich grass along the lower slopes of the Gurbun Saikhan, where the mountains insured a greater rainfall.

They belonged to a short-tailed species of antelope, *Gazella gutturosa*, which lives only on the grass lands. They gather into great herds in both the spring and the autumn and I had often seen two or three thousand does together just before the time of giving birth to their young in early June. The long-tailed gazelles, which belong to a typically desert species, never assemble, I believe, in large groups. Probably this fact is due to desert conditions; for in the arid regions there never would be food for a great number of individuals in any one place.

We were ready to leave the Flaming Cliffs on

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August 12. Even though we had been there for five weeks, specimens were still being discovered and each one seemed finer than the last. Kaison found a beautiful skeleton, nearly complete, just before we left. It was lying on its belly, head out, with all four legs drawn up as if ready for a spring. Apparently the animal had not moved since it dropped there in death ten million years ago. It was too fine a thing to leave, even though I was anxious to get away, and I told Kaison we would wait while he took it out. But three others, which Olsen and "Buckshot" discovered, were left untouched. We had to stop somewhere; for apparently there was an inexhaustible supply of specimens in the wonderful basin. From that one locality our collection numbered sixty cases of fossils, weighing five tons. It included seventy skulls, fourteen skeletons and twenty-five of the first dinosaur eggs ever seen by human eyes. As Granger and I looked for the last time upon the glorious spires and battlements of the Flaming Cliffs, we felt that the desert had paid its debt.

CHAPTER XIII

PROFESSOR OSBORN VISITS THE EXPEDITION

AFTER leaving the Flaming Cliffs, the last two weeks of the expedition before we turned homeward were devoted to an exploration of the Oshih Basin which Granger had discovered in 1922.

At the time, while I was hunting ibex and big-horn sheep at Artsa Bogdo, Granger had spent a most profitable fortnight removing specimens. He had found a small and very primitive dinosaur which Prof. Osborn named *Psittacosaurus mongoliensis*. This animal represented a distinct and entirely new family of Iguanadons which are probably related to the great Iguanadon of England and Belgium.

Granger also discovered teeth and parts of the skeletons of enormous dinosaurs belonging to the group known as the Sauropoda. The bones were so badly preserved that only a few were taken for identification, but their great size indicated dinosaurs seventy or eighty feet long, larger even than the *Brontosaurus* and *Diplodocus*. *Brontosaurus*, which means—the thunder reptile—was named by Prof. Marsh who remarked that, probably the earth

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thundered when the creature walked, but that anyway it was a "thundering big animal!"

The Oshih Basin was the first place where we had found the remains of these huge dinosaurs and their discovery was one of the most interesting results of the expedition. It definitely identified the strata as belonging to a very ancient geological period, either the lower Cretaceous or upper Jurassic. The Oshih Basin is one of the most interesting places that we have found in all Mongolia. It is a long, narrow valley enclosed by rugged hills. We came to it through a rocky gateway which Granger had discovered in 1922. In the centre of the basin rises a beautiful mesa, more than one hundred feet high. It had precipitous walls of red sandstone, capped with dull black lava, like a gigantic cake covered with chocolate frosting.

At the southern end we found the remains of what had once been a great wall built of lava blocks. This must have been constructed by some pre-Mongol people, and probably had a religious significance as it was not in a position for defense. We drove eastward to the end of the valley, which breaks off abruptly in a wild chaos of rocky chasms. The basin floor had been cut into such strange, fantastic shapes that it gave to our camp an atmosphere of unreality. We seemed to be living in the world of yesterday where, at any moment, dinosaurs might wander to the doorways of our tents from out of the vast red canyons.

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While sitting in camp one day I saw a splendid mountain sheep silhouetted on a pinnacle of rock projecting from the mesa; and every night we heard the mournful howls of wolves and the sharp bark of foxes deep down among the tortuous ravines.

But, in spite of its beauty and the promise of rich deposits which the first rapid exploration had given, the Oshih Basin proved to be a disappointment. By some extraordinary chance Granger had found the finest specimens in his first two weeks of work and nothing of great importance was discovered after careful prospecting.

One of the men did locate a most interesting and tantalizing skeleton of a dinosaur which had been completely turned to iron. It was in a great block of hematite and after the hardest steel tools had been blunted we had to abandon it. Even if we had been able to remove the entire block containing the skeleton, its preparation in the Museum would have been well-nigh impossible.

Just before we started homeward on the 25th of August, the whole expedition went to Artsa Bogdo for three days' hunting. Every man shot at least one sheep or ibex and we turned eastward as happy as children on a picnic.

Prof. and Mrs. Henry Fairfield Osborn were due to arrive in Peking early in September, and, while the expedition carried on work at the Well of the Mountain Waters, McKenzie Young and I drove three hundred miles to Peking to meet the president

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of the Museum. I had given instructions for the expedition to encamp in the Valley of the Jewels near Iren Dabasu and there await our return with Prof. Osborn.

Never will I forget the shock I received as I stepped from the train in Peking. My wife met me with Col. Dunlap and Lt. Col. Williams and gave me the first news of the destruction of Yokohama by earthquake. The steamship *President Madison* on which Prof. and Mrs. Osborn were travelling was due to leave Yokohama on the day that the earthquake occurred. I had suggested that they go by train to Kobe and it was highly probable that they had been in the midst of the disaster.

For three days, without success, we used every means to learn what had become of the *Madison* and the other vessels supposed to be in the harbor of Yokohama. In the meantime the Osborns were sailing toward Shanghai, blissfully unconscious of the terrible death which they had so narrowly missed.

On the 9th of September my wife and I met them in Peking. I was so full of the discovery of the dinosaur eggs and our other great finds that, in spite of my resolutions, I could not even wait until we had reached home, but told the story to Mrs. Osborn before we had left the platform.

Prof. Osborn and I went almost immediately to Kalgan to join the expedition in the Valley of the Jewels. At four o'clock in the golden sunshine of a Mongolian afternoon, we saw the blue tents swim-

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ming in the desert mirage. They hovered and danced on the heat waves in the air, finally settling to earth like great blue birds as we neared the camp.

It was one of the greatest days of my life and of the expedition when the man, whose brilliant prediction had sent us into the field, stepped from the car at our camp in the desert. The next days were like the fulfillment of a dream both to us and to the professor. Granger had discovered a splendid *Titanotheres* skull and left it in the ground partially excavated so that Prof. Osborn might actually see in position one of the animals that he had prophesied would be found in Central Asia.

He inspected all of the important fossil localities in the Valley of the Jewels and at Iren Dabasu. A specimen in which he was greatly interested was a single tooth representing an archaic group of hoofed mammals known as the Amblypoda.

None of these great ungulates had hitherto been found in Eurasia, excepting *Coryphodon* of the lower Eocene of France and England. This single, upper pre-molar tooth was the only specimen of the group we had discovered in two years' search. Prof. Osborn considered it so important that he asked to be taken to the bench about two miles from camp, and to have me photographed on the spot where I had picked up the tooth.

Later we drove ten miles down the valley and stopped for tiffin. As we were returning, Prof. Osborn pointed to a low, sandy exposure a half-mile

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away, and said: "Have you prospected that knoll?"

"No," I said, "it is the only one in the basin that we have not examined. It seemed too small to bother about."

"I don't know why," said the Professor, "but I would like to have a look at it. Do you mind running over?"

When we stopped at the base of the hillock, I did not leave the car, but Prof. Osborn and Granger walked out to examine the exposure. As he left, the Professor turned to me with a smile and said, 'I am going to find another *Coryphodon* tooth.'

Two minutes later he waved his arms and shouted, "I have it—another tooth!"

I could hardly believe my eyes and ears. Jumping out of the car, I ran to the spot. The tooth that I had found was the third or fourth upper pre-molar of the right side. The one that he had discovered was the third or fourth upper pre-molar of the left side and almost exactly the same size. Naturally they could not have been from the same specimen as the two had been found eight miles apart. The explanation of this remarkable telepathic coincidence is left to the psychologist.

The last night before the expedition returned to Kalgan we camped in a beautiful amphitheatre among grass-covered hills. Prof. Osborn and I sat for two hours discussing the future of the Mongolian explorations. We had opened a new country which

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had given undreamed of revelations in the pre-history of the earth.

It was obvious that the work could not be concluded satisfactorily in the five years originally allotted for the expedition. Eight years, we estimated to be the minimum, and our decision was made before the Mongolian twilight had faded into darkness.

All of the staff were to return to New York to study and assemble the collections. I was to begin a campaign to obtain additional funds to carry on the work and to reorganize the expedition on its new basis. All of the plans were carried out successfully and the year's interruption of our exploration not only provided additional financial support through contributions from almost every state of the Union, but it served to give fresh inspiration to the members of the staff for their future years in the desert.

CHAPTER XIV

BIGGER AND BETTER EGGS

OLD Merin, the leader of our camel caravan bade farewell to me at the gate of the compound in Kalgan on February 20, 1925.

"When the geese fly north across the Gobi," I said, "we shall meet at the 'Place of the Muddy Waters.' Good travelling, and may the blessings of Buddha be on thee and all thy children."

"We will be there, O Honorable Master, never fear. Good travelling to thee, good travelling."

Like sunlight flooding the brown reaches of the desert a smile rippled across his wrinkled face; then swinging to the back of his huge white camel he disappeared into the yellow dust-cloud behind the caravan.

It was forty degrees below zero on the great plateau and eight hundred miles to Shabarakh Usu, the "Place of the Muddy Waters." Eight hundred miles of daily battle against cold and snow and February gales through a region swarming with bandits. Ten men with one hundred and twenty-five

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camels carrying six months' supplies of gasoline and food.

All things are uncertain in Mongolia, yet I believed that when the spring had come I would sit beside the *argul* fire in Merin's tent at the Flaming Cliffs.

Cold and snow meant nothing to him—they had been a part of his life since childhood. Brigands too, he had always known. Time after time he had piloted our caravans safely to some desert rendezvous, circling robber bands, sleeping by day in secluded hollows and travelling by night. Time after time he had appeared smiling with his camels when we had well-nigh despaired. Yes, I felt sure that he would win through again.

Three months later our seven motor cars piled high with men and gear roared across the Mongolian grass lands. Two hundred miles from Kalgan we glimpsed a splash of red on the summit of a hill. It was a lama waving his sash. He galloped toward us on a rangy camel, our Mongols advancing to meet him. For five minutes there were explosions of staccato questions and answers; then I got the report.

"Merin has been stopped at the *yamen* (official post) on the frontier. The soldiers will not let the caravan go or any of the men leave. He told this *lama* to find us on the way."

We could not understand why Merin had been held, for the Mongolian Government at Urga had issued a special permit for the camels to cross the

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border without duty or examination. But I knew the insolent breed of petty officials and suspected that it was for the purpose of extracting "squeeze." Every Chinese caravan has pitiful tales of their activities in this respect!

Whatever the reason a serious blow had been dealt the plans of the expedition at the very outset. Instead of having our base of supplies eight hundred miles out in the centre of the Gobi, the caravan was only half that far. It meant four hundred miles of forced marching across a desert of terrible aridity and we must begin the summer's explorations with thin, worn-out camels.

From nomad Mongols in the next hundred miles we gleaned additional scraps of information. The caravan was held, rumor said, because it contained ammunition. Soldiers were waiting on the trail and I was to be taken to Urga and shot; our boxes had been ripped open and the camels so closely guarded that they could not get good feed. They had been held a month. Altogether it was a most discouraging report.

We had the satisfaction of knowing that right was on our side. True enough one of the boxes did contain shot-gun shells but we had a "blanket permit" which allowed our caravan to cross the border regardless of what it carried.

We camped at the "Well of the Mountain Waters" eighty miles from the *yamen* where the fossil hunters could begin work at our old titanotheres locality. The

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next day six of us heavily armed set out in three cars.

Since the *yamen* officials had ignored the credentials issued by the highest authorities of their own government at Urga we could either enforce our rights or abandon the expedition. I was certain that a show of force would quickly intimidate the ignorant wretches who are accustomed to bullying the helpless Chinese but we were fully determined "to go the limit" if necessary. Therefore, when we finally encountered six Mongol soldiers who had been sent to arrest us we treated them with scant courtesy. One of them was bundled unceremoniously into the car and told to direct us to the *yamen*. The place was a collection of felt covered *yurts* with a large one in the centre. A hundred yards away we saw the American flag over Merin's tent beside the long line of boxes and camels.

Our Mongols welcomed us like joyous children. Merin's story was substantially as we had heard it except that the damage to our supplies was not so great as I had feared.

Five minutes after our arrival an insolent young Buriat swaggered in with a message from the *yamen*. I was under arrest and must prepare to start for Urga at once. The head man would send word when he was ready to receive us and the cars must not move from the spot where they were standing.

"Tell your chief that *we* are ready to see him *now*," was the reply I sent back. Following closely on the messenger's heels all six of us approached the *yurt*. The young Buriat reappeared immediately

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saying that the official would not see us then. Leaving Dr. Loucks and Shackelford outside with instructions to act summarily if there was an attempt to "start anything," I pulled up the felt door-flap and stepped inside followed by Granger, Young, Lovell and two of our Mongols. A circle of twenty Mongols and Buriats sat staring at us in fascinated silence. I said nothing for a few moments, then suddenly demanded "Who is the head man?" A lama at the far end of the *yurt*, wearing a gorgeous yellow satin coat and a sable-bordered hat raised his hand. "How dare you ignore the passport of your government and hold our caravan?" I asked. "You are a bandit. Explain instantly."

From the moment of our entrance the lama had been running his beads faster and faster through his hands. At my unexpected attitude he lost all self control, snapped the string and crumpled his rosary into a yellow ball. Finally he managed to stammer that he wanted to pass the caravan but that his soldier colleague would not do so because it contained ammunition; also dangerous seditious literature in the form of *Asia*, *World's Work*, *Outlook*, *Saturday Evening Post* and other American magazines. Moreover, he had discovered a large box of "Eveready" flashlight batteries which he thought were bombs and two old Chinese bayonets used by us for digging fossils.

We listened to him in silence. Then a tremendous bang of my fist on the stove made every man in the

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yurt jump as though he had felt a knife in his ribs. I said that they had ignored the Government permit to allow the caravan to proceed no matter what it contained, that he had ruined many of our supplies, and that we intended to take *him* to Urga to answer for what he had done.

In five minutes the insolence was gone and we had before us a group of frightened natives who asked only that we take our caravan and leave. We could cheerfully have beaten every man there within an inch of his life but that would only have created trouble for the future. The chief thing was to get the camels started for the long march across the desert to the "Place of the Muddy Waters" and they left that night. We returned to camp next day.

The expedition had had a bad start. The afternoon before we left Kalgan, Dr. Berkey developed a temperature of 104° and we had to leave him behind with Dr. Loucks in attendance. I planned to send for them when we had reached a place where work could begin. Then there was the usual bandit scare. Two cars had been robbed just north of Kalgan during the previous week and Field Marshal Feng Yuhsiang, the so-called "Christian General" insisted that it was unsafe to travel. He wanted us to wait two weeks until he had driven off the bandits. Of course, that was impossible and I knew that we could take better care of ourselves than could Marshal Feng's soldiers. Our men were simply spoiling for a fight. Therefore, I signed a paper formally relieving

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the Chinese Government of all responsibility for our safety.

The second night's camp, April 20th, was ninety-five miles from Kalgan. The tents were pitched in the curve of a little stream on a clean yellow carpet of dried grass. There we remained until Berkey and Loucks joined us a week later.

Meanwhile we learned just why Marshal Feng was so anxious for our "safety." Ninety motor cars loaded with ammunition for his army passed over the road. They came from Russia by way of Urga. The Marshal was not at all desirous of having foreigners see what was happening on the road.

The road at the top of the pass was a mass of mud in which the cars sank to the hubs. We don't worry much about sand or rocks or ruts but mud is serious. The wheels cannot get traction and it becomes a matter of digging, packing up, and building a path of stones. Added to the mud for good measure was a terrific sand-storm which well-nigh smothered us. Nevertheless, we made our distance as planned and the next day met Roberts, Chief Topographer, with his assistants Butler and Robinson. They had begun their map at the Kalgan railroad station from a known level and carried it up over the Pass. This level was maintained across Mongolia throughout the entire expedition. It is the first accurate survey ever made in the country, and the photographers deserve the greatest credit for their splendid work.

The holding of our caravan by the *yamen* officials

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necessitated a complete revision of our plans and caused us unending difficulties throughout the entire summer because of the weakened camels. With such a large expedition it is quite enough to combat the physical difficulties of the desert; when to these are added incidents such as I have described in the first part of this chapter scientific exploration becomes well-nigh impossible.

I reported the matter in Urga and the Government officials were duly regretful. In order not to have a repetition, we were given a whole sheaf of documents which presumably would smooth our path. Also we were forced to take two Mongols from the Secret Service Bureau to travel with us, one of whom was to inspect and seal our boxes. Despite these preparations we never passed a *yamen* without disagreeable incidents. The petty officials now stationed everywhere in Outer Mongolia are surpassingly insolent. They consistently ignored the papers given us by the highest authorities in Urga, which were obtained only with the greatest difficulty and expense, and, had we not maintained a very determined attitude, would have made us cease our work. Nevertheless the expedition progressed successfully in spite of these annoyances. With such a splendid staff it could not do otherwise.

Our revised plans necessitated a considerable wait at Shabarakh Usu, while the caravan trekked across the intervening four hundred miles of gravel desert. For motors it was splendid; for camels, awful. The

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vegetation would hardly feed a sand rat; the wells were a hundred miles apart. Our camels would have to draw nourishment from fat stored in their "humps" but they had little enough of that for the *yamen* soldiers would not let them go to the good feed. I told Merin to travel quickly and leave the weakest animals behind or let them die. He promised to arrive in twenty-one days. He was two weeks late but one night we heard a wild Mongol song in the moonlight. It was answered from camp and everyone ran out in pajamas to see Merin silhouetted against the sky on the rim of the basin. Ninety-six camels were close behind him and the caravan was safe.

We, ourselves, reached Shabarakh Usu without difficulty. The late afternoon sun threw wonderful purple shadows into the chaos of red ravines when we halted on the edge of the great eastern canyon. It was there at the Flaming Cliffs that we had found the famous dinosaur eggs in 1923. With what it has given us since, I suppose Shabarakh Usu is the most important single locality in the world from the standpoint of palæontology.

My car was in the lead and I had worked up to the opposite slope before the others picked their way into the chasm. They looked like tiny black ants on the surface of a vast red wall. One could not conceive of them as being automobiles!

Shabarakh Usu is a famous place and it is one of these spots that lives up to expectations. You look



The first dinosaur nest to be found as it looked when uncovered by George Olsen at the Flaming Cliffs in 1923.



Protoceratops skull outlined against the rock where it was buried. Flaming Cliffs, 1925.

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into a vast pink basin studded with giant buttes like strange living beasts, carved from sandstone. One of them we named the "dinosaur" for it resembles a huge *Brontosaurus* sitting on its haunches. There are mediæval castles with spires and turrets, brick red in the evening light, colossal gateways, walls and ramparts. Caverns run deep into the living rock and a labyrinth of ravines and gullies make a paradise for the palæontologist. Like a fairy city it is ever changing. In the flat light of mid-day the strange forms shrink and lose their shape; but when the sun is low the Flaming Cliffs take on a deeper red and a wild mysterious beauty lies with the purple shadows in every canyon.

There had been little change since we left in 1923. The tracks of our motor cars were filled with sand but still distinct; the old camp site on the basin rim was marked by a heap of discarded stone blocks each containing an incomplete skull of a dinosaur which had lived there ten million years ago. In 1925 our tents were pitched on the basin floor near the well. I loved the spot for I had only to raise my eyes to see the sculptured ramparts of the Flaming Cliffs shimmering in the Gobi mirage. A few hundred yards to the north was an area of shifting sand now dotted with a "forest" of tamarisks, the stunted desert trees. There we discovered traces of the "Dune Dwellers," a race that lived in the Old Stone Age twenty thousand years ago. The tamarisks are all under fifteen feet in height, yet Dr. Chaney, our

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botanist, found by sections that many of them were more than two hundred years old. They gave us gorgeous camp fires and every night we sat for an hour listening to our Sonora phonograph and discussing the new discoveries. I never shall forget those evenings! There were fourteen of us and every man brought to the fire a tale of his day's work which would read like a novel. Chaney had new plants or a few bits of paper-shale with stems or leaves millions of years old which threw a flood of light on the climate and vegetation of Mongolia when only strange, cold blooded crawling things inhabited the world. The geologists told a fascinating story of what was happening to the plains and mountains in those far, dim days. Roberts was showing on his beautiful maps, topography that we could not see and never dreamed existed until his contour lines brought them out. From the palæontologists we always could expect a new thrill for they were finding treasures greater than the wealth they had uncovered in the first year.

We never said so publicly, but all of us had a secret feeling that more dinosaur eggs could be discovered if we returned to the Flaming Cliffs. There was little doubt that we had found all that were exposed in 1923 for our palæontologists had combed the Red Beds inch by inch. Granger, Olsen and the others do not miss things when they really get to work. They are not that kind of men. But two winters of wind and frost and blasting gales had

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stormed the cliffs and one summer of fierce day heat and cold nights had split the rocks. In some spots a year or two makes little change; in others it may work miracles. We hoped that the Red Beds was such a place and our hopes came true. There *were* more dinosaur eggs—nests of them, singles, whole ones, broken eggs, big ones and little ones; eggs with smooth, paper thin shells, eggs with thick striated shells. In short, more eggs, different kinds and bigger and better eggs than any we had found the first year. The knives of wind and frost and rain had worked wonders in that soft, red sandstone. It had swept the obscuring sediment from the surface of hundreds of feet of rock and cliff laying bare enough to give a clue to what was underneath. In some spots it was only half an inch or less but that was enough to expose a tiny bit of shell or the tip of a white bone.

Chance, luck, coincidence, or whatever you wish to call it, often leads to the most important discoveries. Several have happened during the three years of this expedition which I don't dare tell about because the stories are never believed. The skull of the giant *Baluchitherium* was found that way. After relating the incident in two lectures and watching the expressions of tolerant amusement on the faces of my audience I gave it up. People never will realize that truth often *is* stranger than fiction.

I rather expect that the public will think we "planted" a nest of dinosaur eggs which Lovell found

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on the very rim of the basin with a sheer drop of two hundred feet below them. But I am going to tell the story anyway, since there are thirteen other men to vouch for it and we have photographic evidence of the nest's position, at least.

Norman Lovell is a motor transport expert but his tastes run to anything that has an element of risk in it. He was always poking about the Flaming Cliffs looking for eagles' nests which usually were so high that he would have to cut steps in the sandstone wall to reach them. It was in this way that he found the dinosaur eggs.

A kite's nest lay just under the edge of the great peneplane which sweeps down from the Gurbun Saikhan and breaks off at the basin. After several unsuccessful attempts to climb the face of the cliff he gave it up and approached the nest from above "to see what he could see." Crawling on his hands and knees to the very edge, he lay flat on his stomach trying to peer into the nest when his hand struck something sharp. It was the knife-like edge of a broken dinosaur egg shell! The upper parts were gone but the remains of fourteen eggs were in their original positions firmly embedded in the rock. Perhaps in another few months of weathering this section of the basin rim would have broken away and the eggs have been smashed to bits on the rocks below. There was nothing but pure luck in this discovery because the only eggs in Lovell's mind were those of the kite which he expected to find in the nest below.

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We reconstructed the scene exactly as it happened for Shackelford's motion picture camera, but one incident occurred which was not in the original. While Lovell was making his first unsuccessful attempt to scale the face of the cliff he had dislodged several huge pieces of rock. Shackelford insisted that this must be done again; it was "good action."

Climbing up Lovell disappeared behind a projecting ledge while "Shack" ground off the film, meanwhile shouting, "A little more speed; give us something real." A second later there was a crash and down came a great mass of rock with Lovell following, tumbling and rolling almost to the camera. He was covered with red sand, his face was bleeding and there was a terrible bruise on his hip, but thank Heaven, no bones were broken. Shackelford believed that Lovell was performing for his especial benefit and kept on taking pictures shouting encouragement the while.

It was a delicate and extremely dangerous operation to remove the eggs. A high wind blew the entire time and Walter Granger had to lie at full length to avoid being swept over the brink. He took out the entire block of stone containing the nest and the eggs will be freed from rock at the Museum. Although the tops of the eggs are broken the lower halves of all of them are almost certain to be intact and will make a splendid exhibit.

As soon as we arrived at the Flaming Cliffs, I promised a bottle of real "pre-war" to the man who found the first eggs. (We had only three or four

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bottles for "medicinal purposes.") This started great competition. George Olsen qualified on the second day. His discovery included five almost perfect eggs. It was another bit of luck which may be hard to believe. George was prospecting in the gully where he discovered the first eggs in 1923. Not thirty feet from the site of the original nest he saw a bit of shell fragment in the loose sand; a few yards further up the slope was a larger piece—then no more. Crawling on hands and knees he went over every inch of ground but there was not a trace which could lead him to expect the presence of more eggs. Impatiently, he drove his collector's pick into a cracked rock overturning a chunk weighing fifty pounds. Adhering to the under side were four dinosaur eggs, three of them unbroken. The fourth was cracked in half and the end of the fifth fitted the fragments which had led him to the nest. The discovery was fifty per cent pure accident because Olsen does not often waste time and energy in turning over rocks when he cannot see fossils. These eggs are now in the Field Museum of Natural History, Chicago.

Olsen is the champion dinosaur egg hunter of the world! "Bigger and better eggs" was our slogan and he outdid himself and all the rest of us by a find which he made just before we left Shabarakh Usu for the last time. It was an even dozen eggs, larger and finer than any that have yet been discovered. They had broken out of a low shelf of rock and were

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lying buried in soft sand. All he had to do was to brush them out; after fitting the fragments together they can be put on exhibition in the Museum.

These eggs are almost perfectly elliptical and about nine inches long. In fact, they are nearly the shape of a loaf of French bread. Their beautifully striated shell shows a variety of patterns on different parts of the same egg. Although the shell of this type is one-eighth of an inch thick and very solid, a group found by Dr. Loucks had shells of almost paper thinness. They are only four inches long and remarkably slender with pointed ends. Then there is a smooth shelled type a trifle larger in size and one or two still bigger varieties with pebbled or pitted surfaces.

Without a doubt these represent different species and probably genera of dinosaurs. It seems probable that the larger striated-shell types which are most abundant were the product of *Protoceratops andrewsi*. This dinosaur which was the ancestor of the huge *Triceratops* found in America, was only about nine feet long. The thin, smooth-shell eggs may have been laid by several varieties of the smaller carnivorous dinosaurs, bones of which we found in 1923.

It is certain that this summer we discovered at least two types which were not represented in our 1923 collection. The abundance of eggs in this single locality is most surprising. In 1923 we obtained twenty-five specimens, in a more or less fragmentary condition. This year at least forty were discovered

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of which fifteen or twenty are well preserved. The Flaming Cliffs must have been a great dinosaur incubator. Half a dozen spots were found on the higher levels where there were thousands of fragments but no complete eggs. Dr. Chaney picked up seven hundred and fifty pieces in one afternoon. Probably most of these represent eggs which were broken as the cliffs weathered away but undoubtedly some were nests where the baby dinosaurs had hatched. One Mongol woman, whose *yurt* was in the sand dunes not far from our camp, learned that she could reap a harvest of tin cans in payment for dinosaur egg shells and appeared daily with a handful.

In 1923 we found most of the eggs near the floor of the basin but this summer they were discovered at levels all the way up to the very rim. There is a difference of two hundred feet between the lowest and highest nests. It would require a very long time to deposit two hundred feet of sediment. Therefore, this spot must have been used as a dinosaur nesting place for thousands, probably hundreds of thousands, of years.

What was it that brought the reptiles to Shabarakh Usu generation after generation? The abundance of egg shells shows unquestionably that it was a point of great concentration, at least during the nesting season. Feed or water would hardly explain it. It seems to me that part of the answer at least lies in the peculiar quality of the sand. Like living reptiles dinosaurs scooped out shallow holes and laid their

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eggs in circles, with the ends pointing inward; sometimes there were three tiers of eggs, one on top of the other. We found one nest arranged that way. There the hen-dinosaur covered her eggs with a thin layer of sand and left them to be hatched by the sun's rays. The covering sediment must, of necessity, be loose and porous in order to admit warmth and air to the eggs. It is quite conceivable that the sand at this spot was particularly well adapted in its qualities to act as an incubator.

The geologists have confirmed their original opinion that this deposit was formed by wind-blown sediments. The red sand is extremely fine and could be transported by the wind for a long distance. The evidence favors the existence of lakes to the south where the Gurbun Saikhan (one of the spurs of the eastern Altai Mountains) now stands. Streams doubtless ran into them and at least one passed through the Red Beds. Therefore food and water probably combined with the excellent sand to make ideal nesting conditions for the dinosaurs. Our palæontologists found bits of fossilized wood in these beds. Dr. Chaney has identified them roughly as that of a desert type of tree. Combined with the geological evidence this indicates arid, or semi-arid, conditions ten million years ago when these dinosaurs existed.

Moreover, Prof. Victor Van Straelen of Brussels, who has studied the microstructure of the dinosaur egg-shells, says,

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“From the rugosities of the outer surface, together with the rare and extremely small pores, it is right to infer that the eggs had no outer cuticle. This is a character shown today by birds and turtles which lay their eggs in very dry regions. We may find herein a confirmation of the desert conditions prevailing in Mongolia during the formation of the Djadokhta beds.”

The dry country and the loose sand probably explain how such delicate objects as eggs were so beautifully preserved. After they had been deposited the dinosaur covered them with only a thin layer of sediment; just enough to conceal them from egg-thieves. Even today as we have good reason to know, gales which drive and pile up sand are frequent. In a wind storm five or six feet of sediment might easily have drifted over a nest. The warmth of the sun could no longer penetrate to the eggs and incubation abruptly ceased.

The weight of heaped-up sand eventually cracked the shells, and the liquid contents of the eggs ran out. Simultaneously the extremely fine sand sifted into the interior making the solid cores which are present in all our specimens.

The loose sediment of the entire region eventually became consolidated into red sandstone, the matrix in which all the eggs are enclosed. Thus, it can readily be understood why some of the nests have remained for ten million years exactly as the mother dinosaur left them for the last time.

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The Gobi Desert is the only place in the world where dinosaur eggs have been discovered up to the present with the possible exception of some fragments from Rognac, France. Although conditions had to be exactly right for the preservation of these delicate objects, it seems strange that similar beds have not been found elsewhere. We know of one other locality in Mongolia. Just what it will produce we are not prepared to state for it has not been carefully investigated. Still a few bits of shell were found there. It is a long way from Shabarakh Usu and is a million years or so younger. Since the dinosaurs of that formation were generally larger we hope to find an egg or two that will satisfy the public as to size.

I hope we can, for I have had a lot of explaining to do. Few people realize that there were big dinosaurs and little dinosaurs just as today there are pythons and grass-snakes. When the public see an eight or nine inch egg it is horribly disgusted. It demands something about the size of an office safe. It visualizes only the great Sauropod dinosaurs, *Diplodocus* or *Brontosaurus*, reptiles which could have looked into a second story window if there had been houses at that time. Those dinosaurs must have laid eggs, it is true, and perhaps we will find one sometime. But until then the ones we have must do. After all a nine foot dinosaur, which was mostly tail at that, could not be expected to do much better than a nine inch egg! That is a ratio of an inch of egg to a foot of dinosaur. Personally, I think it was a pretty good effort.

CHAPTER XV

THE DUNE DWELLERS OF MONGOLIA

COLUMBUS received a certain amount of credit when he discovered America and the world gives him even more today. Yet a good many sceptics maintain that Columbus was only an "also ran." They say that the discovery of America had been made a few hundred years earlier by Lief Erickson or some other Norseman. But they can't prove it! We of the Central Asiatic Expedition honestly thought that we were the original and only discoverers of the famous dinosaur eggs in 1923. For two years our lives have been considerably brightened by the thought that we were the first to expose the product of the "hen-dinosaur" to the gaze of human eyes. It has been a lot of fun to overhear someone say in awe-struck tones, "Oh, he was one of the men who discovered the dinosaur eggs." But last summer we found that we were all wrong. Albeit innocently, we have deceived the public. If we dared, we should keep very quiet about it. But as surely as the sceptics have plucked

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leaves from the laurels of Columbus, someone would rob us of honor sooner or later, probably sooner. The fact is, and I confess it with deep regret, we were not the first discoverers of the dinosaur eggs. Quite a number of other people had beaten us by the comfortable margin of fifteen or twenty thousand years. Moreover, I should not be a bit surprised if dinosaur egg shells had a sound market value even as early as B.C. 18,000.

This is the story. Last summer while we were hunting for more dinosaur eggs at Shabarakh Usu we found evidences of a new race of people who had lived there away back in the late Palæolithic, or Old Stone Age. Among other things that they had used as ornaments were bits of dinosaur egg shells. They must have picked them up at the Flaming Cliffs where we got ours. We found in their flint work shops, many bits about one-half inch square together with egg shells of a giant ostrich. These had been used as a necklace for some primitive débutante.

There you have our confession. We cannot honestly say any longer that we are the discoverers of the dinosaur eggs, and we hereby withdraw all such claims. But we can say that we discovered the discoverers of the dinosaur eggs. Perhaps that is even better.

"The Dune Dwellers of Shabarakh Usu" is the name we gave to the people who stole our glory. It is appropriate because they lived in the sand dunes which are heaped about the roots of the tamarisk

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trees on the floor of the basin. Of course, fifteen or twenty thousand years has made a good many changes in the face of the country. To solve the problem of those changes and learn what manner of people the Dune Dwellers were from the scraps of evidence they left behind, was perfectly thrilling. It isn't given to every one to discover the existence of an entirely new race of people. We had much more fun out of it than in finding the dinosaur eggs because after all, "the proper study of mankind is man." Moreover its importance in prehistoric archæology is enormous. It has been strongly affirmed by many scientists that most of the primitive races whose remains have been discovered in Europe came from Asia. That wave after wave arrived from the east each one driving out or annihilating the people they found in possession of the region. Many of these races left stone tools or weapons which were highly characteristic of their particular culture. The questions of greatest interest when we began to work out the life story of the Dune Dwellers was where they fitted into the mosaic of primitive European cultures. Did their weapons and tools represent a type known from Europe? If so was it earlier or later than the European equivalent? If it was earlier it would indicate a migration from Asia to Europe for it hardly seems probable that two types of similar culture would develop independently in two widely separated regions.

We were not entirely unprepared for the discovery

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of the Dune Dwellers. In 1923 Walter Granger prospected the red sand layer in the tamarisks for several hours and brought out a few chipped flints which he believed to show human workmanship. Although he was so occupied by the influx of dinosaur skulls and skeletons that he never returned there, we had it in mind when we decided to begin archæological work in Mongolia. Mr. M. C. Nelson was dubious about the prospects for his investigations when he arrived in Peking. He had been subjected to the usual discouragement of being informed that there was nothing in Mongolia by scientists who had never been there. All of us have had the same experience. We were told that it was impossible to use motor cars for exploration in the Gobi Desert; the geology was all obscured by grass or sand; as for fossils it was ridiculous to expect to find them where they never had been found before! I was called all sorts of a fool for even attempting scientific exploration in such a barren region. It required a certain degree of courage to go forward under such conditions the first year but now we only have to say "Wait and see. We can afford to take a chance."

Nelson began to be encouraged shortly after leaving the grass lands for he discovered artifacts at almost every camp site and very often along the trail. These were stones which had been fashioned into tools by chipping the edges with other stones.

Before the tents were pitched on the day of our arrival at Shabarakh Usu, Shackelford wandered

off into the tamarisks. He had an instinct for finding interesting things and at dinner produced a pocketful of chipped flints. Nelson pronounced them to be of undoubted human origin. "Shack" said that they were there in hundreds.

The next morning Nelson and I went out immediately after breakfast followed by Berkey Morris and Loucks. We found an area of shifting sand blown into dunes against the stems of twisted tamarisk trees. Sculptured red bluffs marked the entrance to shallow valleys floored with sandstone where the wind had swept the loose sediment away.

On the clean hard surface of the rock, flakes of red jasper, of slate, chalcedony, chert and other stones were scattered like new fallen snow. Pointed cores, neatly shaped where thin strips had been flaked off, tiny rounded scrapers, delicately worked drills and a few arrow heads gave Nelson the first indications of the type of culture with which he had to deal.

We held a consultation. "Where did the artifacts come from? Could they have been washed down from the surface?" Those were the first questions to be answered. We must find flints actually in the rocks and bones to date the deposit geologically.

Shortly after our consultation I discovered a bit of egg shell of the giant ostrich *Struthiolithus*. The other men came on the run when I shouted. It was like "pay dirt" to a prospector for gold. This great bird existed in the Ice Age and if the makers of our



The caravan, with Merin walking at its head, picking a difficult way down the Flaming Cliffs.



Members of the expedition consulting on routes westward of Kholobolohi Nor, 1925. *Upper row, standing, L. to R., H. O. Robinson, George Olsen, Ralph Chaney, F. K. Butler, Nels Nelson, Harold Loucks, Norman Lovell, I. B. Shackelford. Lower row, seated, L. to R., J. B. Roberts, Roy Chapman Andrews, Walter Granger, F. K.*

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flints were its contemporaries their culture must belong to that period which dates from about fifty thousand to about five hundred thousand years ago. A few yards to the left Morris found another fragment of egg shell *drilled with a neat round hole*. This was human work. Nelson said it was one of the beads in a necklace.

We were in a fever of excitement for the trail was getting hot. Nelson, the most conservative of conservatives, was skipping about from place to place like a boy of sixteen. At last Berkey found a spot where half a dozen chipped flints were securely fastened in the sandstone of the valley floor. We made much of him for his discovery, only to find it had already been marked by Shackelford the day before! Before noon we had discovered a dozen such spots and were satisfied that some of the artifacts had weathered out of the lowest level and had not washed down from the surface of the dunes. Still, until we found shell of the ostrich eggs or fossil bones actually in position, we could not be certain that the deposit was of Pleistocene age.

An unlooked-for complication entered when we began to discover fragments of pottery. It was primitive enough, to be sure, but a people who used such crude stone implements had no business to be making pottery. The problem became more interesting and more complicated every hour. It could be solved only by the method that a detective uses in unravelling a mystery—inductive reasoning

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from the bits of evidence left behind by this long dead race.

The Central Asiatic Expedition is organized on the basis of correlated work and I have never seen its advantages more clearly displayed than in the solution of the Dune Dwellers problem. The geologists, palæontologists, topographers, and botanist all assisted the archæologist. Without such a combination of expert knowledge *available on the spot* it would have been impossible to settle many of the puzzling questions presented by this great deposit.

The subject became so interesting that it was difficult to keep to our respective jobs. Everyone wanted to hunt artifacts and bring in contributory evidence for the final solution of the problem. Dr. Loucks, surgeon, was one of our most enthusiastic workers. In company with Dr. Berkey he discovered a vast workshop where flint chips were scattered over the surface in tens of thousands. They took four of our Mongols to the spot one morning and returned with fifteen thousand flakes. Nelson worked for days sorting the pile and selecting such as were valuable for specimens.

The second day's work revealed dark spots in the lowest layers of the soft red sandstone. Evidently these were ancient fire-places. When they were cut through in cross section layers of ash containing charcoal, flints and burned stones were revealed. Very soon we discovered square bits of dinosaur and ostrich egg shells embedded in the sandstone. This gave us

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pause. It was then that we realized that the Dune Dwellers were the original discoverers of the dinosaur eggs. About that time Dr. Loucks found quantities of the ostrich egg shell on the surface of the peneplane. Thus another element of uncertainty was added to our first hypothesis. If the Dune Dwellers picked up bits of fossilized dinosaur egg shell at the Flaming Cliffs, two or three miles away, and brought them to their workshops they might have done the same with the ostrich eggs! Therefore, even if we did find shells embedded with the flints, it proved nothing about the age of the deposit. It might be of the Ice Age, forty thousand or fifty thousand years ago, or post Ice Age.

A few bones were discovered in position but they were so badly preserved that we were not able to identify them. Probably they can be determined at the Museum.

After ten days of intensive work the evidence was well in hand and certain pretty definite facts stood out. Nelson could state confidently that the site at Shabarakh Usu had been occupied by human beings for thousands of years. There were at least two successive cultures represented. The men of the lowest and oldest level were much more primitive than those of the upper strata. Their culture was late Palæolithic or Old Stone Age; they did not make stone spear or arrow points or pottery. Above this layer there was a transition stage which gradually developed into the Neolithic, or New Stone Age.

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Stone arrow and spear points and crude pottery characterize these later people.

By geological methods it was determined that the lowest strata in which artifacts were found is early post-glacial. Dr. Berkey estimates it to be about twenty thousand years old. When I say "post glacial" I speak in terms of European chronology for there is evidence that there never was an ice sheet in this region. In Ikhe Bogdo, in the Altai Mountains, Berkey and Morris found glacial cirques but they are certain the ice rivers were confined to the mountains and never reached the plains.

Mr. Nelson believes that the artifacts indicate a culture most similar to the Azilian of France and Spain so named from the Mas d'Azil in France. Yet there are some differences which can not easily be explained. Besides stone tools the Azilians used implements and harpoons of stag horn but not a sign of worked bone did we find in any of the Mongolian deposits.

The Azilians also had singular burial customs, characterized by separate interment of the heads of corpses. Groups of Azilian skulls have been found imbedded in ochre and all facing west.

The Azilian culture is placed at the end of the Old Stone Age, about fifteen thousand years ago. Thus our Dune Dwellers appear to be considerably older than the Azilian men. An interesting question arises: Did the Dune Dwellers migrate to Europe and establish the culture which is known there as

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Azilian? They could have brought with them the technique of their flint industry and adopted the use of bone after arriving in Europe where stags were abundant in the heavy forests.

That the Dune Dwellers were widespread in Mongolia is certain. During all our explorations wherever the proper conditions were found, their artifacts were present. For camp sites they always selected the low basin and valleys which then, as now, were occupied by sand dunes. Probably this was because such basins gave them water as well as fuel from the stunted tamarisk trees.

Shabarakh Usu was by far the largest deposit that we discovered. The geologists determined that there had been a series of transient lakes in the great basin which extends northwest to Ulan Nor, the Red Lake. I can imagine the tamarisk grove as swarming with these strange people. Dressed in skins, probably living under rude shelters of hides or bushes, they hunted, fought and loved much as do the primitive savages of Australia or Tasmania. Some members of the tribe developed unusual skill in fashioning implements of stone. These artisans did their work at certain spots where the flakes of jasper and chalcedony now lie in thousands. "Work shops" we call them.

From stone cores they pushed off long slender flakes to make knives and drills. The edges of some are as sharp as those of our hunting knives. A tiny scraper not much longer than my thumb-nail with a

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rounded edge was the most characteristic tool. These were used to dress skins or to smooth sticks.

In the work shops most of the specimens were stone flakes; they were like the shavings which the carpenter leaves when he planes or chisels a piece of wood. We found many broken or partly finished implements which had been discarded for some reason when the stone proved undesirable. Naturally, the completed tools were less numerous. They had been carried away from the work shops for daily use.

The source of supply for the peculiar kinds of stone needed by the Dune Dwellers puzzled us for a long time. We found it when returning near the end of the summer. It was on a flat plain thirty-six miles from Shabarakh Usu. There were quantities of red jasper, chert, chalcedony and agate, and hundreds of these stones were roughly chipped. Nelson was not with us at the time and we were all greatly excited for it seemed certain that these represented a very early Old Stone Age culture, pre-Chellean or Chellean perhaps one hundred fifty thousand or two hundred thousand years old. Nelson dampened our spirits considerably when he arrived. After spending several days studying the deposit and collecting specimens he stated positively that these coarse, rudely chipped pieces were only test stones which had been thrown away by the Dune Dwellers when they came to get materials. The primitive artisans selected the best chunks, after testing many and took them to their work shops to finish. It was

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like a modern lumber yard where the carpenter goes to select his wood.

Nelson started a hot controversy in camp. We were not at all willing to abandon our idea of a new early Palæolithic culture without a fight. Berkey returned with him to reëxamine the site and the rest of us marshalled every argument we could think of to defend our theory. But Nelson went about demolishing us one by one in the most cold-blooded way. The worst of it was that he knew a lot more about the subject than we did. After he had arranged a series of specimens in comparative rows we finally had to admit that he was right.

Such discussions are most valuable. The expedition's work is so correlated that every discovery affects the other branches of science directly or indirectly. Therefore, when a man advanced a new theory he had to be prepared to defend it from a half dozen angles. If it survives the barrage laid down by the whole staff he can feel pretty safe in adopting it.

It is because of these constant discussions in camp that I have no hesitation in making very definite statements when the results of our summer's work are announced to the press the day after we reach Peking.

We hoped, up to the very last, to find burials at some of the artifact localities where bones of the Dune Dwellers might be obtained. Skeletons would tell us what manner of men they were. We looked

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for them particularly in the vicinity of their hearths and permanent camping places, such as Shabarakh Usu. But not a trace of human bone could be found. Either their dead were not buried near the camps or the conditions were unfavorable for the preservation of bones. The latter is probably the correct reason for the fragmentary animal bones in the flint bearing layers being badly preserved.

Had we been able to discover caves, probably much more definite information could have been obtained. But caves are as scarce as hens' teeth in the region we explored. Although limestone is present in places, the erosion has not been of the type to produce caverns or even rock shelters. The Dune Dwellers must have lived in the open the entire year. Since at that time the winters were probably as cold as they are today, I don't wonder they migrated.

While we were trying to solve the riddle of the Dune Dwellers and piecing the evidence together bit by bit, one of the members of the Expedition played an amusing trick. He found a small bit of rusted iron saw and planted it neatly in the flint bearing layer. Dr. Berkey was the one who discovered it first. There was consternation in camp. It completely upset all our theories and gave us a bad hour. For men of the Old Stone Age do not make saws. But fortunately Nelson had found another section of the same saw near the tents and exposed the joker.

We determined to get even with him and that quickly. He was an enthusiastic collector of birds'

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eggs and spent every leisure moment blowing and labelling them. Shackelford and I got two well matched hens' eggs and had the cook boil them hard. Then they were beautifully stained in potassium permanganate. I found a bush near the sand dunes where the ground was splashed with bird droppings, scooped out a shallow depression, and set the eggs.

A pair of demoiselle cranes lived near the spot and I told our victim that probably there was a nest in the vicinity. He never had seen a crane's egg, so the rest was easy.

When I returned to camp and announced the discovery he was all excitement. Four of us piled into a car and ran down to the spot. He was so delighted that I almost relented and confessed the joke. Then I remembered the saw and hardened my heart.

After our victim had photographed the "nest" from three angles and made a close up with the portrait attachment for his camera we went back to camp. Word had been passed around and eight or ten men gathered to see the *dénouement*. First attempts at blowing were not successful and after a serious discussion as to the best method of preservation he decided to remove the embryo through a hole in one side. I will never forget the expression on his face when he discovered that they were hard boiled! With a roar he hurled one at Mac Young and the other at me, but we already had a good start across the desert.

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Practical jokes on an expedition may lead to bad feeling but our victim was a good sportsman. He knew that he deserved all he got after the episode of the saw. Still, he assured me that I headed his list of preferred funerals and that sooner or later I would "get mine." I did, too. It was when we were eating the last of the twelve hundred eggs that we brought into the field. An innocent looking but especially prepared boiled egg was served me at breakfast and when I broke the shell a flood of pink water soaked everything on my plate. Then all bets were settled.

During the five months that the expedition is in the desert as a rule we are completely isolated from the outside world. The few caravans which we meet always have left China before us so they have no recent news. We might use wireless but that was prohibited by the Mongol Government. With no letters, newspapers or telegrams we must create our own little world of pleasures and interests. Good fellowship is just as necessary as good science. In our expedition where every branch is so closely interrelated team work is essential. The prevailing opinion, I am sure, is that we are a group of "dried up scientists" that we all wear big spectacles and long beards and use words of five syllables when we ask someone to pass the salt; that our conversation is only of science and that such mundane things as the latest musical comedy on Broadway doesn't enter into our scheme of life.

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Most of us do wear spectacles, it is true, as a protection against the sun. My eyes were ruined forever in 1922 by the terrible glare of the desert. As for beards we find it more comfortable to shave every two or three days.

It would be amusing if those who hold this opinion of us could be present at our dinner table almost any night. There is science at times, to be sure, but a lot of other conversation besides; and laughter enough to keep us sitting there for hours.

I am afraid that another fallacy might be dispelled by a glance into our mess tent. We have table cloths and clean ones at that! The table cloth is one of my hobbies. After a hard day's work when one is tired and cold and perhaps a bit discouraged it is very restful to sit down to a table covered with a clean white cloth. Eat well, sleep well and dress well, then one can work well! In the main camp we were always pretty comfortable. When we were off on side trips or advance explorations we were primitive enough to suit anybody, but that never bothered us.

All this was splendid as long as no cogs slipped in the wheel of organization. But let something go wrong and we realized quickly enough that we were a long, long way out in the middle of a desert that is a real desert in spots. To keep forty men well fed and comfortable and above all *busy* was my particular job. It was made easy, for no one ever complained no matter what the circumstances; it would be difficult to assemble a staff who pulled together more

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splendidly. I have only praise and great admiration for them all.

The Mongolian weather was a surprise to the new men. Last summer there was virtually no great heat and twice as much rain as usual. I spent every night in my fur sleeping bag. The changes from winter to summer and back again were bewildering.

On the twenty-fourth of May while Mac Young and I were *en route* to Urga to obtain certain permits we fought our way through snowdrifts for three days although it was perfect mid-summer weather when we left Shabarakh Usu. The Flaming Cliffs whirled and danced in the heat waves reflected from the basin floor. A huge black raven drowsed upon a rock with beak half open and even the spotted lizards were too sleepily content to snap at the sand-flies which crawled incautiously beneath their pointed snouts. To think of snow was absurd. Yet a few hours later we were shaking with cold and battling an icy gale which whipped sand and gravel against our faces like bursting shrapnel.

At seven o'clock in the evening when we saw a lone *yurt* beside the trail both of us had had more than enough. The only inmates of the dwelling were a young lama and a wrinkled hag, aged seventy, with a baby of four or five. They made us welcome and piled dry *argul* (cow dung) upon the fire until our numbed bodies had begun to warm. In half an hour the mother of the baby arrived—a strapping young Mongol with a frame like a foot-ball tackle. She

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had been out all day looking for a flock of sheep that had been lost in the gale while the man toasted himself at the fire. When more *argul* was required he never dreamed of moving but told the old grandmother to bring it in.

The circular, felt-covered *yurt* was like all others. Opposite the door and a red chest stood a Buddhist picture and a few sacred family offerings. At one side was a bed platform four inches high; the man slept upon it, of course, while the women had two strips of felt on the ground. At the other side of the *yurt* was a wooden rack holding bowls of curdled milk; close beside it two calves and half a dozen baby lambs and goats were tied to a rope. The *yurt* reeked with mingled odors of mutton fat, rancid butter and living goat but it was *warm*. We slept in our tent. The gale tore at the fastenings but we were comfortable in our fur bags. In the morning the interior of the tent was one great snow bank. Our clothes were somewhere in the drift and you can imagine how pleasant it was to dress in wet, frozen garments! The front of the car had been covered with a canvas hood. When Mac started the engine a peculiar muffled sound came from the interior. He found that it was as solidly banked as though we had shovelled snow inside.

That day and the next was a constant battle. Often when ploughing through the white blanket on a smooth plain, the car would suddenly drop into a ravine packed six feet deep with snow. It was

a terrible sickening feeling when everything seemed to go out from under us. Then there was nothing for it then but to dig around the motor, jack up the wheels and pave a road with stones until we could get out. Poor Mack had to bear the brunt of all the work for my right shoulder was still virtually helpless from a crash in the New Year's steeplechase at Tientsin and I was only of use to pick up stones or drive.

The third day really was the most tiring for the sun was glorious and had begun to melt the snow. A mountain range separated us from Urga by thirty miles but the pass was so drifted that we had to climb up steep slopes to avoid the snow. The tires slipped on the wet grass and the car would move forward only when we built a path of stones to give traction. After five hours of the most strenuous work we were three miles from our night's camp. But our troubles were at an end when we gained the summit of the pass and ran down the steep slope into a beautiful valley. In the snow filled ravines lay the bodies of horses and cattle that had dropped into the white death traps. Some of the animals were still alive but too weak to move. I longed to end their sufferings with a bullet yet it would only have meant trouble with the Mongols. That blizzard took a terrible toll of life all across the northern grass lands for it came so suddenly that then atives were unprepared.

From the crest of a hill to the south, Urga lay like a

beautiful jewel set in the green valley of the Tola River. We could see the vivid roofs and golden cupolas of the Living Buddha's palace nestling in the poplars at the base of the Bogdo Ola, God's mountain. Towering above the city was the great temple surrounded by the cubicle of ten thousand lamas. Peaceful enough it looked in the spring sunshine but I knew that it was a city of suspicion and one not to be entered without due thought of how one was to get out! John T. McCutcheon, the famous cartoonist, and Barney Goodspeed of Chicago were to visit Urga sometime in May and we hoped to get news from them. But they had left the day before we arrived and caught the tail end of the blizzard to the eastward on the Kalgan-Urga trail. The snow was not so deep in that region and they got through with only a day or two delay.

I met General P. K. Kozlov again in Urga. With the exception of Prjevalsky, whom he accompanied on his early expeditions, Kozlov is the greatest of Russian explorers. Although more than sixty years old, he has all the enthusiasm of a young man.

The privilege of knowing this splendid explorer and his delightful wife will ever be one of my most treasured memories. At that time he was preparing for an expedition to reëxcavate Kara Khoto, an ancient city which he had discovered some years earlier buried in the sands of the south central Gobi. In the summer of 1924 he had found some remarkable tombs of the Tang Dynasty in the forests sixty-five

miles north of Urga, and I had visited the excavations with him; it was an experience which I never will forget.

Kozlov and I made plans for our two expeditions to meet at the Altai Mountains near Shabarakh Usu, but they did not materialize. Doubtless, he was delayed by the work on the tombs which had not been completed when I left Urga.

A fortnight had passed before Young and I returned to Shabarakh Usu. It was like reading an absorbing novel to hear the story of what had happened in our absence. The work had been completed most gloriously and all was ready to move westward to Tsagan Nor, the beautiful White Lake at the base of the Altai Mountains.

We brought the men news of the outside world, a few letters and some new records for our Sonora phonograph. That evening we sat about the camp fire until long after midnight listening to the divine voice of Caruso float over the tamarisk grove where the Dune Dwellers had lived twenty thousand years ago.

CHAPTER XVI

A TRAGEDY OF THE GOBI DESERT

THREE million years ago, when the world was old but its life was young, strange tragedies were enacted even as there are tragedies today. The records of some of them were writ in stone and still remain for those to read who know the language. One story I shall translate, as we read it from the rocks in the storm-swept wastes of the Gobi Desert.

It was a summer's morning in Mongolia. Full-fed upon succulent leaves, the greatest mammal that ever walked upon the earth stood at the edge of an open forest. Its legs were like the pillars of a temple; its body a heaving mountain of living flesh. The sun was high. After a long drink, the creature would compose its vast bulk in the cool shade to sleep away the sultry midday hours.

Lazily it moved across the meadow toward a half-dry stream-bed, where shallow pools glittered in the sunlight. A nightmare beast it was, huge beyond belief, lumbering down the bank into the sun-baked wash. Reaching the nearest pool, it stooped to drink.

Suddenly its fore feet sank in yielding sediment. With a great heave it wrenched them free, but took one more, fatal stride; then the quicksand gripped its legs. Bellowing with terror, heaving, straining, the creature tried to drag itself from the bottomless well of death. Deeper it sank. The treacherous, golden sands reached its breast, its shoulders, then closed above its back. Only the massive head with its staring blood-shot eyes protruded from the sand. A moment later that, too, had disappeared, and the death-trap with its bait of shimmering water waited for another victim.

That is the story we read on a June day in 1925, three million years after the colossus of Mongolia had been swallowed by the treacherous sands. We had come in motor-cars and had pitched our tents close beside the unsuspected tomb. Twenty miles away rose the silver peak of a snow-crowned mountain; a blue lake lay at its feet. In front, a chaos of red-and-grey ravines had been slashed in the gravel plain that swept like a yellow floor to a black waste of lava-capped mountains on the north.

These had not been there when the giant lumbered across the meadow for its last drink at the fatal pool. Since that day hills had been built upon its tomb and worn away; and the green meadows and parklike forests had given place to the arid reaches of the Gobi Desert.

The credit of discovery belongs to Liu, one of our Chinese collectors. His sharp eyes caught the

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glint of a white bone in the red sand on a steep hillside. He dug a little and then reported to Granger that he had found something. Granger completed the excavation and was amazed to find the foot and lower leg of a *Baluchitherium*, standing upright, just as if the animal had carelessly left it behind when he took another stride. Fossils are almost never found in this position, and therefore Granger sat down to think out the why and wherefore. There was only one solution. Quicksand! It was the right hind foot that Liu had found; therefore the right front leg must be about three yards down the slope. He took the direction, measured the distance and began to dig. Sure enough, there it was, a huge bone like the trunk of a fossil tree, also standing upright. It was child's play to find the feet of the left side; for what had happened was obvious.

When all four limbs were excavated, each one erect in its separate pit, the effect was extraordinary. I sat down upon a hilltop to drift in fancy back to those other days when the tragedy had been enacted. It was plainly told by the great stumps, even though they could not speak. Evidently the huge beast had settled back upon its haunches, struggling desperately to free its front legs from the gripping sands. It must have sunk rapidly, fighting to the end, dying only when the choking sediment filled its throat and nose. If it had been partially buried and died of starvation, the body would have fallen on its side.

The geologists told us what the spot was like before

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the Altai Mountains had been pushed up through the earth. From the fossil wood, Dr. Ralph W. Chaney described the climate and vegetation. Thus we had the background of the tragedy.

Why could we not have found the gigantic skeleton complete, standing erect, ready for exhibition! It would have been a specimen for all the world to marvel at. "Walter, what do you mean by getting only the legs?" I said to Granger. "Why don't you produce the rest?"

"It is your fault," he answered. "Why didn't you bring us here thirty-five thousand years earlier before that hill weathered away?"

True enough, we had missed our opportunity by just about that margin. As the entombing rock was eroded the skeleton was cut off bit by bit and now lay scattered in ten thousand fragments on the valley floor. Some of them we salvaged, but they are a pitiful wreck of the colossus of Mongolia. Still, there is always hope, and in another year we may open a tomb with a skeleton intact.

The region of the White Lake must have swarmed with baluchitheres. We found at least a dozen spots where skeletons had crumbled with the hillsides and were strewn over acres of the plain. There were remains of other animals, of course, but rodents outnumbered all the rest, some of them ancestors of species in southern France. Literally thousands of teeth and jaws had weathered out of the sediment and were sown over the red slopes.

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Although the trees and meadows of three million years ago have given place, around the White Lake, to arid reaches of the Gobi Desert, we had our most beautiful camp at the lake. We came to it along the northern base of the Altai Mountains, the great chain of peaks which thrusts its mighty arm southeastward into the desert. The trail was very bad for the cars. We had to fight our way through sand and mud, rocks and "niggerheads," pushing, digging, smashing in an endless battle. No cars should be required to endure the punishment we had to give our fleet, but not a single part gave way. Every night, no matter how hard the day's work had been, McKenzie Young and Norman Lovell made a thorough inspection, tightening bolts and screws. It was this devoted care that made it possible to take the cars where we did.

Dozens of tiny, threadlike streamlets, which twisted and divided as they came down from the mountain slopes, were most annoying because they seemed so harmless. Two or three feet deep, with perpendicular banks, they were just too wide to jump. At every one we had to build a bridge of sod and renew it after a car had crossed. It was time-consuming and exhausting work, but on June 10 we came in sight of the White Lake.

What a disappointment! The beautiful lake was only one-fourth as large as when we saw it last in 1923. Long stretches of evil-smelling mud encircled the water; the brilliant green vegetation had given place to a margin of dull yellow grass, and the water's

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edge was four hundred yards from our old camp-site on the beach. When N. C. Nelson, the archæologist, drove in, he remarked with disgust: "Tsagan Nor! It is little, and it stinks."

But after our first disappointment, we began to enjoy the camp. It certainly is the most beautiful spot we have found upon the great plateau. In the changing colors of sunset, Baga Bogdo, the mountain beyond the lake, with its vast alluvial fans sweeping out from mysterious canyons, has an unreal, ethereal beauty. I never tired of gazing into those lonely gorges in which the only inmates are ibex and bighorn sheep.

Between the mountain and the lake lie miles upon miles of sand-dunes, stretching in a yellow line to the east and west. The sand is as fine as that on a perfect beach. The dunes are of the usual barckan, or crescent, shape; many are well-nigh two hundred feet in height, with sheer drops on the leeward faces from the knifelike summits. In the bottoms of the valleys are patches of long coarse grass and sometimes a tall bush-pea with beautiful purple blossoms. Much to our surprise, there were damp spots in a half-dozen valleys, and Shackelford, our photographer, dug a well with his hands. Clear, cold, fresh water was only four feet beneath the surface.

In the late afternoon, when the low sun threw grotesque, curving shadows and brought into strange relief the modelling of the sand and the ripple-marks on it, the dunes were beautiful beyond description.

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But withal it was a sinister beauty; for to be caught in that maze of shifting sand in a desert gale means death to man or beast. Many times, in safety across the lake, we watched the crests whirl and stream like spray from monster waves. Blinding, choking sand would suffocate everything that breathed and bury it in a yellow grave within an hour.

An old Mongol who had lived all of his seventy-three years near the lake told us that when we were there in 1923 the water was near its highest level. Forty years ago the lake had been entirely dry; doubtless it would fail this year, since there was no water in the little river that gave it life.

Dr. Charles P. Berkey and Frederick K. Morris, the geologists, decided to use Tsagan Nor as a type study for desert lakes. We had our own observations of 1923; the former beach-lines were well marked; and we could get the history of the lake from the Mongols. The basis of the study must be a map, and L. B. Roberts with his assistants, F. B. Butler and H. O. Robinson, produced a chart of which we all are proud. Day after day in the scorching sun they tramped the shores with plane, table and alidade. More than three thousand "shots" were taken. Nothing like this standard of accuracy in map-making ever has been attempted on the Central Asian plateau.

They found that the lake has an altitude of 3,828 feet. Seven beach levels were apparent, the highest being thirty-three feet above the present shore-line.

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Although there were a few inches of water spread over the panlike floor of the lake on our arrival in June, when we returned on July 16, after a reconnaissance to the west, our beautiful lake was gone. In the centre of the white mud-flat sat a lonely sheldrake, sole survivor of the clamoring flocks of wildfowl that formerly had rested here.

The study of the White Lake gave an illuminating view of recent climatic changes in Mongolia. Climate certainly has been the most important factor in determining the origin and migrations of human, as well as animal, life. To learn what the climate of the Central Asian plateau has been in the past was one of the chief problems confronting our geologists. It was to help solve this that I added Dr. Ralph W. Chaney, the palæobotanist, to our staff. The fossil vegetation would give us a sure indication of what the climate had been in successive geological periods.

Berkey and Morris have concluded that there was a definite *climatic cycle* in Central Asia; in other words, that for millions of years there have been successive stages of moisture and dehydration—"pulses," Ellsworth Huntington has called them—with an ever-increasing aridity. Since the end of the Ice Age, the drying up of the plateau has been rapid. Moreover, our geologists are convinced that ice-sheets never covered Mongolia as they did parts of Europe and America. They formed cirques, ice-beds, in some of the higher peaks of the mountains, but

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apparently the glaciers never reached the plains. This determination affects most vitally the hypothesis of the development of human life on the Asiatic plateau.

So far as we are aware, Baga Bogdo, the snow-covered peak opposite the White Lake, never had been climbed by a foreigner. Dr. Harold H. Loucks and Butler ascended it on June 24, camping the first night two thousand feet up, at the summit of the alluvial fan on the first gorge to the west of Tiger Canyon. The following morning was rainy, and a thick fog enshrouded the mountain, but they started the ascent at six in the morning and reached the summit at one in the afternoon. They remained only fifteen minutes; for it was bitterly cold, and the clouds enveloped them so closely that it was impossible to see more than a few yards. After planting the American flag and that of the New York Explorers Club on the highest point, they built a cairn of rocks and left a letter-head of the Central Asiatic Expedition in a bottle.

The Mongols have a superstitious fear of this peak. They believe it to be inhabited by fierce beasts, and we were told that no one who attempted its ascent could return alive. Bleeding at the nose would begin and continue until the man had died. For this reason it seems improbable that any of the natives have made the ascent, although, as mountain-climbing goes, it is not particularly difficult.

At the base of Baga Bogdo there were a number of

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circular mounds enclosed by stones, which Nelson, our archæologist, believed to represent graves. The Mongols could give little information about them, and Nelson opened a half-dozen without finding bones. At last he obtained a fairly well preserved human skeleton, but no implements. Without doubt the graves are more than a thousand years old and represent some pre-Mongol people, possibly the Turki Uigurs.

Some distance from the lowest slopes of the mountain the palæontologists investigated a deposit of grey Pliocene clays in which I had found a beautifully preserved stag-horn in 1923. The Pliocene, just before the beginning of the Ice Age, is conservatively estimated to be a million years old. At that time the White Lake region must have been well forested but with open savanna-like plains. Fossils of true horse, *Equus*, stag, mastodon and a giant ostrich were found. The pelvis of a mastodon was a huge bone measuring sixty-four inches across, but Granger did not consider it worth removing. Another interesting discovery was what evidently had been the nest of an enormous ostrich, *Struthiolithus*. Hundreds of shell fragments in a single spot indicated that here the young had hatched out of their eggs. The skeleton of this avian giant is unknown, but the eggs, which are often found in the loess deposits of North China, show that it must have been twice as large as the living ostriches.

After the various branches of work had been well

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started at the White Lake, Shackelford and I went out for motion-pictures, with the camera strapped in the rear of a car. The gravel plain north of the lake swarms with wild asses and antelopes. Seven miles from camp we stopped on the edge of a great depression. Even with the naked eye we could see hundreds of yellowish forms swimming in the desert mirage. Wild asses, without a doubt, but never before had I seen a herd so vast. They were massed in three dense groups on the valley floor, and for miles the horizon was dotted with stragglers. We counted a block of two hundred and could estimate fairly accurately that there were at least one thousand animals in the herd. Subsequently, we learned that there were many more than that; for several hundred were below our sight in the bottom of a shallow ravine.

It was obvious that we must circle far to the east and drive the herd westward on to the gravel plain, where for fifteen miles we had splendid running for the car. When we finally headed toward the asses, a group of forty surprised us before we reached the main herd. The animals began running rather slowly, stopping often to gaze curiously at the car. We did not press them, but maintained a steady pace of twenty miles an hour. The asses kept their distance ahead of us easily enough, and others began to come in from every side. There seems to be a fascination about a car that draws all the desert animals, wild or domestic, like a magnet. The asses came from miles on an oblique course that brought

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them in front of us in a thundering mass. Hundreds were pounding along on both sides, and we were enveloped in such a cloud of yellow dust that I could barely see.

I dropped back and swung to the outside of the largest group. Shackelford, braced on the rear of the car, ground off film, swinging his camera from side to side as the mass divided. But soon the small herds began to converge again, and so the performance repeated itself. By the time we reached the western end of the plain, which drops off steeply into the broad valley of the Tatsin Gol, asses were pouring over the rim like a cataract of yellow water.

When we turned back, we encountered single stragglers running about with their noses held high in the air, trying to find their companions. Yet they could not resist the fascination of the car; before we had gone a mile, more than a hundred were pounding along in front. Fifteen or twenty antelopes joined the parade, running with stiff black tails erect, sometimes springing into the air as if they were on pneumatic tires. I let the herd cross our bows and swing away to the south. With the glasses we could see nine grazing quietly two miles away. We decided to try a new plan. Running a few yards, we stopped the car. The asses looked up, trotted toward us and stood with ears erect. Again they came on, and again. Before long they were within less than two hundred yards, and Shackelford could work with his telephoto lens.

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This seems to be the only way in which to get pictures of the animals not in rapid motion. It is impossible to stalk them on the plain; for there is no cover. They do not come to water-holes; for they seldom, if ever, drink. One cannot successfully lie in wait for them anywhere; for they have the whole vast plain upon which to wander, and feed is as good in one spot as in another.

There is an interesting association of the wild ass and the antelope. They are almost invariably found together, and, when we were running a herd of asses, the gazelles would come from all directions to join the race. At our camp, within a few hundred yards of the tents, we saw a single stallion that slept and grazed, always accompanied by an antelope. The strange pair reminded me of a gentleman with his valet.

Of course the two species of animals eat the same kind of food and inhabit the same kind of country. The sage-brush and stiff desert grass give them such excellent nourishment that they are always fat and in splendid condition. The ass and the gazelle are such perfectly adapted desert types that water is unessential. The starch in the vegetation that they eat is converted into water in their stomachs and is sufficient for their bodily needs. Even at the end of a long chase in the hot sun, the asses perspired very little. The sweat was clear, with none of the soapy lather that proclaims a horse to be out of condition.

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During the first two years of our work in the Gobi, we never saw wild asses in herds of more than fifteen or twenty, but we did not arrive in their country until after the breeding-season. In 1925 the herds numbered thousands. Evidently they collect at favorable localities just before the young are born, as do the grass land antelopes, *Gazella gutturosa*. The young are dropped about the beginning of July, and the asses seek a flat plain, undoubtedly for protection from wolves. Without cover for a close approach, a wolf would have little hope of catching either an antelope or an ass in a flat race.

On June 24th, McKenzie Young and I caught a baby wild ass. Although it had been born only the night before, it ran for more than a mile at a speed of twenty miles an hour. In spite of its being a mare and more gentle than the young thing we captured in 1922, it kicked lustily whenever we approached it. The little one was with us only two days. The second evening was cold, and Robinson donated his fur-lined leather waistcoat as a blanket. Mac put its fore legs through the armholes and buttoned the vest under its belly, and it had an excellent blanket. I presented the collar from my police dog, Wolf. But during the night the little ass escaped. We never saw it again. When later I told the story to a newspaper correspondent, he said that in writing it he could not resist putting a gold watch in the waistcoat pocket!

While the work was going on at the White Lake,

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four of us went westward to explore for new fields. That is my particular job. Being in new country where you do not know what is beyond the next hill, with the touch of danger in trusting yourself to a single car hundreds of miles out in the desert alone, makes it fascinating.

From Tsagan Nor we could see the mountain Ikhe Bogdo, bulking hugely against the western sky. We knew that there was a large lake, Orok Nor, at its base, but none of us had seen it. The run there, over a hard gravel peneplain, a plain worn down by denudation, was delightful, but the lake itself proved to be unapproachable with the car, because of the surrounding sand-dunes. After a hard struggle, we did reach a series of reedy lagoons at its eastern end, swarming with bird life. Grebes, coots, ducks of a half-dozen species, geese, herons, storks, shore-birds, gulls and terns were breeding there in thousands. But we could find no fossil exposures within twenty miles of Orok Nor and reluctantly abandoned our plan of camping on the shore. We were compensated, however, by discovering another lake, Kholobolchi Nor, or the Little White Lake in the midst of fossil-fields—a lake only slightly brackish, with fresh-water springs along its edge.

The Expedition reached this place on June 28th. Tents were pitched on a strip of turf as green as emerald. Mine was not more than two feet from the water's edge, at a point where it cut under a low

bank. With the flaps of the big tent thrown back, I watched nineteen white swans floating quietly two hundred yards away, a great black-and-white stork poking along the shore-line and dozens of sheldrakes trailing their broods of tiny ducklings behind them like waving streamers. In the evening we had a sunset celebration, such as comes only in the desert, and all of us voted that the explorer's life is not so bad.

That night a strange thing happened. We were awakened by fish in the Gobi Desert! Could anything be more paradoxical? A strong wind blew from the west until about two o'clock in the morning, pushing the water over to our side of the lake. Suddenly the wind dropped, and the water receded so quickly that thousands upon thousands of fish, which had been feeding along the edge of the green bank, were left stranded in a narrow strip of mud and sand. Flapping wildly as they tried to work back into the water, they made a noise like scores of people clapping their hands.

When I first stepped out into the moonlight to learn what was going on, I saw thousands of glittering forms about nine inches long at the edge of the lake. Granger and I wakened "Buckshot" and Wang, two of our Chinese. They went wild with excitement and ran for the twenty-foot seine. Soon half the camp was watching them draw the net, bringing in hundreds of fish at every haul. We had some fried for breakfast, but they were too soft and "muddy" to be very palatable. The Chinese liked

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them, however, and spent hours in salting and drying them in the sun for future use.

Shackelford and Loucks secured several fish from Orok Nor, of a species also found in the Little White Lake, and the head of one fish that indicated a specimen more than two feet long. But the fish in the Tsagan Nor are quite unlike those of Orok Nor. This is strange; for the two bodies of water must have been connected not many hundreds of years ago.

Just how these desert lakes were stocked with fish is not entirely clear. Presumably the fish came through streams that flowed into the lakes from mountain ranges. In some cases, fish may have been dropped by birds that had caught them in a near-by lake or stream. At any rate, there the fish are in the Gobi, and, by studying their relationships, we have most illuminating clues in the solution of some of the drainage problems of the great Central Asian plateau.

CHAPTER XVII

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WE had been at the Little White Lake for two days. When the fossil hunters with the archæologist arrived at camp in the evening I walked out to the car for their report. They said very little, but I know the signs of an unusual discovery. Granger couldn't keep a suspiciously satisfied expression from his tanned face.

"Out with it, Walter, what have you up your sleeve?" said I.

"Don't pick on me. I haven't done anything. Nelson is to blame," he chuckled, as I poked him in the ribs.

I whirled on Nels. "What on earth have you been doing, you wretched archæologist?" I shouted. "Hurry up, I can't wait any longer."

"Well," said Nels, "it isn't much, but I guess we've got a skeleton of Pleistocene man."

Pleistocene man! Good Heavens! What we had all been dreaming of for years!

I fired questions like bullets from a machine gun.

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The facts were as follows. During an earlier exploration I had located a deposit of grey clay which appeared to be of the Ice Age. Granger and Berkey confirmed it by bringing in fossil bones of horse and mastodon. Nelson had gone out in the morning to examine it for stone artifacts, or traces of primitive human life. He found nothing until just before sundown, when the great discovery had been made. There was not time to excavate the skeleton and the men returned to camp to report to me.

I could hardly control my excitement and wanted to celebrate, but Nelson, the most conservative scientist out of captivity, said "Better wait. There is always a chance that it is a grave, you know. It might be some pre-Mongol people who buried their dead in this bank." That *was* a possibility, and I postponed the celebration. However, I did not sleep much that night. In my dreams, primitive men were fighting a battle to the death with gigantic fish just outside the tent.

Morning saw us early at the Pleistocene deposit and we waited almost breathlessly while Nelson set to work to excavate the skeleton. It was in loose clay and the matrix was easily warped away. Horrors, a bit of decayed wood! My heart went down and down, when a leg bone was exposed *wrapped in birch bark*. Our dream of Pleistocene man was shattered hopelessly. This was a burial, as Nelson had suggested that it might be. True enough, it was old, but only a paltry thousand years

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or so and that meant nothing in our young lives. It must have been pre-Mongol, for now there are no birch trees within hundreds of miles of this region and there have been none for many centuries.

We had hoped that the man had lived a hundred thousand years ago, when mastodon roamed the forest in the Ice Age. We had hoped that he might have been Neanderthal or earlier—perhaps even as far back as the famed *Pithecanthropus* of Java. I have had disappointments in my life, but that was one of the bitterest I have ever known. There was nothing for it, however, but to laugh and say: "Well, we are on his trail. Wait till next time."

It was interesting, of course, to get the skeleton, for it will tell us much about the early inhabitants of Mongolia and what manner of men they were. The body must have been placed in a grave dug in the bank of Pleistocene clay which overlooks the beautiful valley. Probably branches had roofed the hole, for many bits of wood were mixed with the earth about the bones. Strangely enough, the skull exhibits a very sloping forehead—a primitive character—but this probably is due to crushing and may not be natural. No implements or weapons were present; nothing to give a clue to his tribe or race. Later we found other skeletons, but they were from known graves and did not extend false hopes.

Yet we do know that primitive men who made stone tools like those of the Neanderthals lived near this very spot a hundred thousand years ago. On

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the gravel plain just above and behind the lake, Nelson discovered Old Stone Age implements. They were hammer stones and scrapers, crudely shaped but definite in design and of the type known in Europe as Mousterian, contemporary with Neanderthal man. These stooping, heavy-browed hunters were cave dwellers in Europe, where their remains were first discovered. With spears and weapons of the rudest make they fought the mammoth, bear, and rhinoceros, dressing skins for clothes. They had fire and buried their dead. Sometimes several skeletons have been found in a single grave.

Even though he lived a hundred thousand years ago, Neanderthal man was a wanderer. Europe, Africa and recently Palestine have produced his bones; now we know that he lived in Asia, for our stone implements are distinctly of his make.

In 1923, two Jesuit explorers, Père Licent and Abbé Teilhard de Chardin, found a great deposit of Mousterian implements in the Ordos Desert, just south of the region in which we have been working. Among the bones of rhinoceros and other mammals were heaps of egg shells of the giant ostrich *Struthiolithus* which raced across the plains of Mongolia and north China. Evidently these primitive humans had gathered the eggs for food. Since a single egg was nearly twice the size of that laid by a modern ostrich and would have equalled a dozen and a half hens' eggs it was a delicacy not to be despised.

The deposit found by the Jesuits in the Ordos was

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on the shore of an ancient lake, long since "drowned" by drifting sand. Thus it is probable that in Asia Neanderthal man, or his counterpart, was a lake shore dweller. He could not have lived in caves, for there were few if any in this region. It is probable that he sought the protection of a bank not far from the water's edge, and he may have built himself a shelter of branches roofed with skins.

The fact that in Asia primitive humans lived in the open makes it infinitely more difficult to discover their remains. Although in the Ordos Desert the Jesuits found evidences of long occupation of a single site and at Shabarakh Usu we discovered a spot on which primitive men must have dwelt almost continuously for twenty thousand years or more, not a trace of human bones did either of us find. In the case of the Ordos locality it probably means that the tribesmen buried their dead at some spot away from their camp site, because the bones of other mammals were preserved. In the case of our Mongolian Dune Dwellers the interments may or may not have been near their dwelling on the old lake shore. For some reason conditions were not favorable there for the preservation of bones, human or otherwise. We found charred bits near the fireplaces, but complete bones of any kind were almost non-existent. Although many thousands of animals must have been eaten at their camp during hundreds of generations, the bones were not preserved. What became of their dead we have yet to discover. It is possible, of

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course, that the early men of Asia did not bury their dead, but from what we know of primitive human life in Europe, it is fair to believe that they did make definite interments.

That some of us will find primitive human bones in the near future is probable. The problem would be greatly simplified were we dealing with cave dwellers, but I believe that success will come if we persist.

It is only by finding skeletons or skulls that we can definitely correlate our Asiatic primitive men with those of Europe. Their "culture," the types of implements which they made, and the methods of shaping the stone tools tell us that there was a relationship. It is improbable that two corresponding types of culture would have been developed independently in widely separated parts of the world. It is much easier to believe that there was a common origin for the European and Asiatic cultures which show such close similarity. The question is, Where did the ancestral stock develop?

Now that Neanderthal man with his accompanying culture has been found in Palestine and Africa his possible migration route from Asia is easily mapped. As yet it can be considered only as an hypothesis, but there is excellent ground for believing that it will be proved to be a fact.

If it is true that this branch of the primitive human race had its origin in Asia the view that the Central Asian plateau was the homeland of much earlier types

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of man will be greatly strengthened. Professor Henry Fairfield Osborn's brilliant prophecy that it was the centre of distribution for much of the mammalian life of the world is being more fully demonstrated with every year that we work in Mongolia. Day by day we are gaining a fuller knowledge of the climate, temperature, flora, and general conditions during the Pleistocene and the early Ice Age, when we conceive man's development to have begun.

Since our geologists are convinced that an ice sheet never covered central Asia during the Pleistocene at the time Europe and America were being successively invaded by glaciers, we have a very important factor in the hypothesis of human evolution on the great plateau. It is evident that a million years ago and less, the Gobi was a very different place from the desert of today. The temperature was not so low; the climate was much less arid; trees and meadows existed where now there are desolate wastes of sand and gravel. Our geologists believe that during the last hundred thousand years Mongolia has suffered a rapid dehydration. This alone is sufficient reason for the migration of primitive men to Africa, Europe, and other regions where life was easier and game more abundant.

The fact that the Jesuit fathers made their discovery of Mousterian flints in the Ordos and we found the same type several hundred miles to the north, indicates that a hundred thousand years ago Neanderthal man was widely distributed in Mongolia.

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We found the same to be true of our Dune Dwellers, who lived about twenty thousand years ago, at the end of the Old Stone Age. Wherever the red sandstone stratum in which their flints occur was exposed, there we found artifacts. In the basin below the bluff where Nelson discovered the supposedly "Pleistocene skeleton" he obtained a good representation of their culture. Near Orok Nor the red sandstone appeared again, but he found no flints. This was explained by the fact that the stratum lay *below* the old beach levels of the lake. Evidently the water had covered the region after the Dune Dwellers had lived there and their implements had been washed away.

Chaney, Shackelford, and Loucks spent several days in the lagoons of Orok Nor photographing and botanizing. They found hundreds of water-fowl. Coots, horned and small grebes, red-heads, mallard, ruddy and shoveller ducks, bar-head geese, swans, storks, and many species of gulls, terns, and shore birds swarmed on the islands of tuli grass. A great flock of white spoon bills was a surprise, as we never have seen them elsewhere in Mongolia. The men were about two weeks late for nests and therefore the pictures were not particularly successful, but Chaney obtained a splendid collection of plants.

The flora is much like that of our American lakes, including water buttercups, bladderwort, pond and duck weed, green algæ, cat-tails and tuli. Oddly

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enough, the arrow leaf, pickerel weed, bulrushes, and several others of the American flora are absent.

The geologists had an interesting week in the mountains investigating cirques, or glacier beds, and found the only birch trees which we have seen south of the Arctic Divide, which is several hundred miles to the north. Doubtless they are the remnants of once extensive forests.

The palæontologists made a most valuable contribution by finding two skulls representing a great group of mammals known as the Amblypods. Except for the two teeth, obtained in 1923, by Professor Osborn and myself, this American group was unknown in Asia, but was one which he had expected would be found there.

The two teeth were unmistakable, and definitely placed the great group of Amblypods as former inhabitants of Asia, but the skulls which Granger obtained at the Little White Lake will tell a more complete story of their relationship to the American forms. This is of the highest importance.

Although there was every reason to believe that the fossil-fields continued westward for a long distance, I was anxious to see what lay beyond the Altai Mountains. Day after day I had gazed at the massive ramparts barring us from the south. The natives related tales of wild camels and of the famed Przewalski horse; they told us of barren gravel deserts, of sand and mountains, of death from thirst. But each tale only strengthened that restless urge

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which every explorer knows—the desire to go and see. The mountains lay there like a silent challenge. We knew that we could cross them on ponies, but could it be done with a motor car? We would never know until we tried. Kozlov, the famous Russian explorer, told me that he had crossed the Altais somewhere near this spot, but he had a caravan of camels. We thought that we had located the pass he used, for we could see a sharp break in the peaks just west of Ikhe Bogdo.

On July 9th, Roberts, Young, Lovell, and I left camp in an automobile with my faithful Mongol, Tserin. We carried an assortment of spare parts, food for a week, and gas to run five hundred miles. Granger knew the general direction we intended to take and that our objective was to get through the mountains some way—if we did not return he could trail us in another car.

After running a few miles westward we headed directly south toward the mountains. Roberts by taking compass directions was roughly mapping our route. From the summit of a low rise we saw a small lake about two miles to the west. Gulls and terns were flying over the mirror-like surface and islets of tuli grass stretched a long green finger toward the centre. From our elevation Roberts sketched the shore-line while I studied it through my powerful binoculars. Slowly it began to dawn upon me that something was wrong about that lake. The beach grew indistinct and the tuli island danced about in a

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most peculiar way. Roberts and Tserin both noticed it, too.

"Bob, I think we had better run over there before you go any further with that sketch," said I, and started the engine. In five minutes we were on the "shore" of the "lake"—only there wasn't any shore and there wasn't any lake. It was the most perfect mirage we had ever seen. Not even a suggestion of water or of the tuli islands and our "gulls" were sand grouse. Yet from first sight, all of us would have staked our lives that it was real.

It is an axiom of Arctic exploration that you never can be certain that land *is land* until you have put your foot upon it. Cloud banks lying over the ice make perfect mountains and coast-lines. It is an axiom of desert exploration that a lake never *is* a lake until you have waded in its waters.

But the mirage served a useful purpose, for during our investigations we had crossed a well-marked trail which led toward the foothills between us and the mountain's base. It took us up a dry stream bed, across a grassy ridge and into another wash. In some places the gorge was wide with bare rocky slopes; in others the stream had cut a narrow canyon and sheer walls towered above us five hundred feet or more; sometimes great rock slides threatened to bar our way, but always there was a gate through which the car could slip.

We emerged into a beautiful valley facing the majestic ramparts of Ikhe Bogdo, the Great Moun-

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tain, its snow-covered peak rising into the clouds. Our trail led up a vast alluvial fan ten miles long, toward a deep cleft in the mountain wall. I realized that it must be a river gorge and probably would be choked with boulders. The fan gave promise of what was to come. A chaotic mass of rocks paved the surface and it seemed madness to drive a car into the débris.

Still Young and Lovell did pilot it safely for ten miles actually into the canyon's mouth. There we stopped and continued on foot. From the summit of a thousand foot cone we could see how the gorge wound in and out among the peaks, passable for horses or camels without a doubt but hopeless for cars. We named it "Kozlov Pass," as it is almost certainly the one the great Russian explorer discovered.

At the western end of this valley the horizon dropped to a level ridge where the mountain chain seemed to break. It looked to be not more than ten or fifteen miles at most, but we ploughed forty miles through the sand before the crest was reached. Then we discovered that the range bent sharply to the south and that higher and rougher peaks lay beyond. There was not a sign of human life, but a dry lake bed ran the entire length of the valley, which swarmed with antelope and wild ass. They were feeding on alfalfa and we found this plant growing wild at half a dozen spots in other parts of the Gobi. I never have seen such a concentration of game in a small

area. Antelope were running beside the car and crossing our course every moment; tiny fawns hardly larger than rabbits jumped out from almost under the wheels, where they had been lying flat on the ground with necks outstretched.

Herd after herd of wild ass pounded along beside us, unable to tear themselves away from the fascination of the car. Most of the ass were mares and many of them were chaperoning fuzzy long-legged colts. It was amusing to see the little fellows bend to the work of keeping up with their mothers. With ears laid back and slim legs flying they put every ounce of strength and determination into what probably was the first time in their short lives that they had run from danger. Once we saw four wild ass fighting. Kicking and biting viciously they kept at it until the car approached and they joined the zoölogical garden which we were driving up the dry lake bed.

In spite of the thousands of animals there was something utterly desolate about the valley. Perhaps it was the black mountain walls which shut us in and the fact that for more than a hundred miles we had not seen even the remains of an old camp fire or the circular mark left by a Mongol tent. All of us were exhausted when we camped at dark in a sandy stream bed. The speedometer of the car registered one hundred and fifty miles, and in that entire distance not a well or stream had we seen. There was a gallon left in one of the bags which would do for

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drinking and coffee, but we did not worry, for in the old lake bed half a dozen patches of vivid green grass indicated that water could not be far below the surface.

Although the Gobi is a real desert the water problem is not so serious as it would appear to be. If one has a shovel and knows the signs an excavation eight or ten feet deep usually will reach water. The Mongols themselves have dug wells almost everywhere. They lead such a nomadic life that their wanderings have taken them into all parts of the desert. Along the main caravan trails there are wells every fifty or sixty miles. Some of them are hundreds of years old, for these camel routes across Mongolia are among the most ancient in the world. As a rule the water is good. Unless there was a dead camel or bad drainage we seldom boiled the water, and we have had no sickness from that source.

During our night in "Deserted Valley" it rained heavily. We had no tents, but, pulling the flaps of the canvas sleeping-bag covers over our heads, we remained perfectly dry; moreover, there was the comforting assurance of sufficient water in the morning.

The day began with hard work. When crossing a dry stream bed the car suddenly sunk to the hubs in moist sand and there it remained for four hours. Experience has taught us to take such things philosophically. With hardly a word every one began to unload and to collect stones. To build a rock

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foundation under the wheels is the only possible way to get out of such a predicament. The quicksand appeared to be bottomless and the stone base was six feet deep before it would hold the jack and the weight of the car.

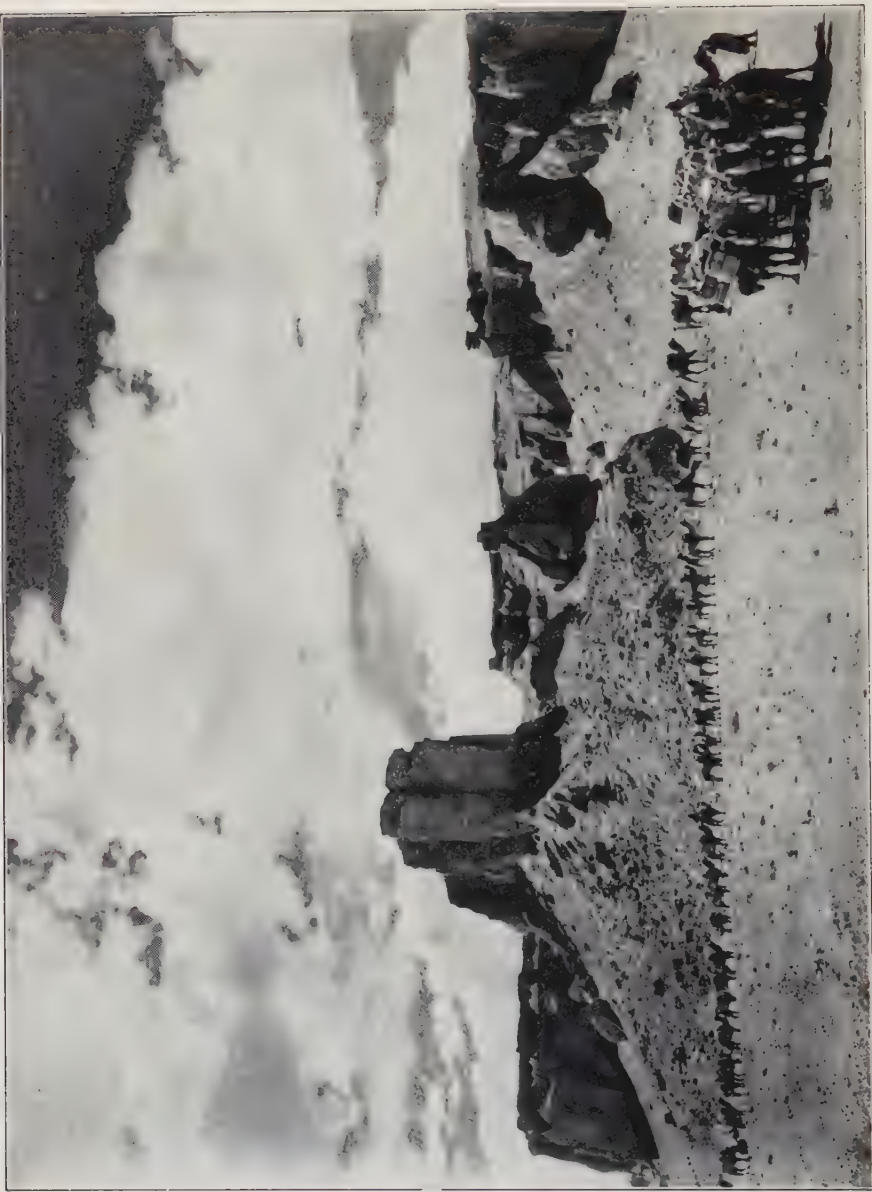
Across the valley there was, in the ragged line of peaks, a dip which suggested a pass. None of us had much hope that it would be possible to get through, but it was the only chance. Crossing the low foothills successfully, we started up the slope only to emerge from behind a rocky corner on the very brink of a stupendous chasm. Red granite ridges capped with dull black lava cut into a thousand fantastic shapes showed against a lowering sky. In the utter stillness it lay like a red inferno. While Roberts took the compass points for his map the rest of us explored the nearest canyon, which divided into a labyrinth of passages and roofless corridors. I suppose that some day when a railroad parallels the Deserted Valley tourists will picnic in the gorge. Of course, they will name it "Dante's Hole."

A long detour took us around the chasm and the break in the saw tooth horizon proved to be a pass indeed. A hard floor of gravel led gradually toward the summit between slanting peaks. It was only seven thousand feet high but it seemed as though we were mounting toward the roof of the world. As the car swept upward we sang and laughed, our spirits soaring with every foot.

From the crest, a vast panorama of low ridges



Mongols studying electric flashlights in camp.



The caravan coming past the Flaming Cliffs on its way to the camp in the Shabarakh Usu Valley, 1925.

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spread out before us like the waves of a great sea in a heavy gale. We could look far into the mysterious region south of the mountains which for us was the "Land of Heart's Desire." But we soon found that its interest lay chiefly in anticipation. It was beautiful but commonplace. Great plains sloped gently downward and the car flew like a bird over the gravel surface.

Not a sign did we see of the reported fossil "bad lands" or the terrible desert of thirst and death; only line after line of pink-white ridges of quartz and marble.

Much to our surprise we crossed a well-marked trail running east and west. On none of the so-called maps was there an indication of a caravan route and it was important for our topographer to learn its destination. We swung east on the trail and found splendid going. The great flat pads of a camel's feet are natural road-makers, tramping the sand until it is as hard as rock.

In spite of the Mongol reports of the lack of water the trail led us to a magnificent spring and just beyond it we saw the blue tent of a great caravan. They were Chinese from Shansi Province. As I know that dialect and we were all wanderers in the desert, they greeted us like old friends. In the big tent we drank tea and ate boiled millet. Twenty men with two hundred camels, they were on the way to Kobdo near the northwestern frontier of Mongolia. It was early May when they left China and as I am

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writing this, on Christmas eve, they have not yet reached Kobdo. Nine months of the same life day in and day out, making and breaking camp, eating and sleeping. Nothing to interrupt the dreary monotony except the winter's fight against snow and cold and perhaps a bandit raid.

Tea, cloth, and tobacco were their goods to barter for camel's and sheep's wool, hides, furs, and ponies. The same trade in the same way over the same trails has gone on for untold centuries and will continue until that not far distant day when a railroad connects China with Central Asia. Then at one blow the romance and glamour of the desert will be destroyed. Tourists will sit in heated cars, eating the food of Europe, reading week-old newspapers, and comprehending not at all the glorious history of the Gobi trails.

The Chinese could give us no late news, but we learned much about the country, for they had made this journey four years earlier. The wild camels and horses were two hundred miles to the southwest, they said, just above the border of Chinese Turkestan; the trail we were on broke through the Altai Mountains and swung north to Uliassutai and Kobdo; for several hundred miles both east and west the country was a gravel plain with no bad lands or exposures where fossils might be found.

It was all negative information from our standpoint and bitterly disappointing. Three more days of exploration proved it to be true. We were forced to

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return for lack of gasoline after exploring six hundred miles, but we had mapped a vast area and eliminated it from our future plans. Moreover, at last we knew what lay beyond the mountains.

CHAPTER XVIII

THE WORLD'S OLDEST MAMMALS

IT was the "zero hour" just before daylight when consciousness is drowned in heaviest sleep. Suddenly I sat up, wide awake, with a strange feeling of unrest vibrating every nerve. Slipping out of my fur bag I stepped through the wide angle of the tent door. There was a heavy stillness in the air, vaguely depressing. A cold nose touched my hand and Wolf, our police dog whined unhappily. He pressed hard against my legs, then stretched his head toward the Flaming Cliffs and gave a long howl like the wail of a damned soul. It made me shiver and I buckled a cartridge belt and revolver over my pajamas before circling the tents with Wolf close beside me. All was quiet. Even the camels, kneeling in two long double lines, nose to nose, were sleeping. It was the tomblike stillness that was so disturbing and back in the tent I made sure that Granger's revolver was in its usual place beside his head. Then I slid into my fur bag while Wolf squatted in the door with his nose high, sniffing restlessly. I didn't like it and couldn't sleep.

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Fifteen minutes passed when I slowly became conscious that the air was vibrating to a continuous even roar which was getting louder every second. Suddenly I understood it all. One of the terrible desert storms was on the way! As the first blast bellied in the tent filling it with a whirl of sand, I ducked into the sleeping bag and pulled the flap tightly over my head. A minute later the "wind devil" had passed and I heard muffled curses from Lovell. His tent was down and under the mass of blue cloth I could see a writhing hump. Eventually Lovell emerged laughing as usual. "I'm all right," he shouted, "but this tent looks like the wreck of the *Hesperus*. I'm going back to bed," and dragging his sleeping bag clear of the débris he crawled in happy as a marmot in a new hole. The "wind-devil" whirled and danced away across the desert and left the air heavy as a pall. In the grey light of dawn we could see an ominous bronze cloud hanging over the rim of the basin to the south. Evidently there was more to come but it might miss us and we decided not to wake the camp. Ten minutes later the air shook with a roar louder than the first and the gale struck us like the burst of a high explosive shell. Even with my head covered I heard the crash and rip of falling tents. It was impossible to see but I felt for Granger with one foot. He was lying across a green suit-case, his face protected by a shirt. As our tent swept away he had leaped to save the box which contained six tiny fossil mammal skulls, the most precious treasures of all our

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collections. For fifteen minutes we could only lie and take it. While I was feeling for Granger the sleeping bag had been torn from under me and my pajama coat stripped off bodily. The sand and gravel lashed my back until it bled and poor Walter on the mammal skulls did not fare much better.

Suddenly the gale ceased, leaving a flat calm. The camp was completely wrecked. All of the fifteen tents were down and men were slowly emerging from the débris, swearing good-naturedly in English, Chinese and Mongol. Our tent was split from end to end and its contents piled in the most chaotic mass I have ever seen. A trail of litter showed the path of the wind toward the tamarisks where the Dune Dwellers lived ten thousand years ago. A third of a mile away we found duffel sacks, wash basins and canvas chairs. The tamarisks looked like Christmas trees—each one bearing fluttering streamers of shirts and trousers and dabs of snowy cotton. Half a dozen chairs and folding tables had been smashed and every tent was ripped. Basins, clothes and plates were sucked into the whirling vortex of the up-draught, carried hundreds of feet in the air and scattered over the desert for half a mile. Never have I known such a violent gale. The velocity must have reached one hundred miles an hour and had our cars not been facing it they certainly would have been overturned.

Fortunately it had passed in fifteen minutes and there was an interval of calm before we had to face the wind again. Every man considered it a joke.

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While we hunted for our belongings in the growing light, without a suggestion from me the cooks made coffee and fried antelope steak. In half an hour breakfast was ready. Can you wonder that with such a spirit the expeditions have been a success?

All this happened when we returned to the Flaming Cliffs of dinosaur egg fame in mid-July. The expedition had penetrated west as far as the latitude of Uliassutai. New fossil fields had been discovered but they were of small extent. Exploration south of the Altai mountains was disappointing. Nothing was left but to back track, cut through the mountains again and try our luck. If that failed there were half a dozen places in Inner Mongolia where we knew rich fields awaited us. Meantime work remained to be done at Shabarakh Usu. Just before we left in the spring I had returned from Urga bringing Granger a letter from Dr. W. D. Matthew, curator of Palæontology in the American Museum of Natural History. Dr. Matthew is one of the least excitable men I know, but he was stirred to the depths when he wrote that letter. He said that a tiny skull in the 1923 collection which Granger had labelled "an unidentified reptile" in reality was one of the oldest known *mammals*. It had been found in the same strata with the dinosaur eggs at Shabarakh Usu. That statement will not sound extraordinary to the majority of my readers but to a palæontologist it is thrilling. Bryan, and all his cohorts to the contrary, we know that out of cold-blooded, egg laying reptiles,

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millions of years ago, evolved the warm blooded mammals which gave birth to their young alive and nursed them with milk. In a hundred years of science only one skull of a mammal from the Age of Reptiles ever had been discovered, although scraps of teeth and jaws were known. That single skull, named *Tritylodon*, from the Triassic of South Africa is in the British Museum and is one of the world's greatest palæontological treasures. But it belongs to a group known as the multituberculata, which died out in the Eocene, or Dawn period of Mammalian life and has no very direct relationship to living mammals.

Dr. Matthew wrote, "Do your utmost to get some other skulls." Granger and I discussed it for half an hour, then he said, "Well, I guess that's an order. I'd better get busy." He walked out to the base of the Flaming Cliffs and an hour later was back with another mammal skull. It was the third of its kind that had been discovered in a hundred years and Granger found it just like that! It paralleled the remarkable experience of Professor Osborn when he told me he was going to find the tooth of a *Coryphodon* and two minutes later picked up the second one ever known in Asia! Such things don't sound possible, I will admit. But they *do* happen, and frequently at that. I never would dare to write them if they were not true for the presence of thirteen other men upon the Expedition, all of whom will read this book, is somewhat discouraging to exaggeration.

Granger's new skull was in a sandstone concretion,

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but appeared to be virtually perfect, as indeed it has so proved. We had to leave for the west the next day but planned to return to the dinosaur egg beds to hunt for more. Granger and Olsen, Buckshot and Liu our two Chinese collectors, did some very intensive searching in the next week. It was close and trying work for the skulls were in little balls of rock that had broken out as the cliffs weathered away. There were millions of such concretions on the basin floor and it was simply a matter of examining as many as possible during the day. When one has looked over a thousand or more with no result in the scorching sun the job loses its interest and becomes a bit discouraging. But Granger and Olsen never were quitters and they stuck at it day after day. By the end of a week they had a total of six skulls; probably it was one of the most valuable seven days of work in the whole history of palæontology.

None of the skulls are longer than an inch and a half. Granger had packed them carefully and they never were out of my sight on the long journey from Peking to New York. With a good deal of formality and relief I presented them to Dr. Matthew at the American Museum on November 9th, 1925. I told him that this was the direct result of his letter. He had asked for "The goods" and Granger and Olsen had "delivered" them.

Within a few hours of my arrival at the Museum, Albert Thompson began the preparation of the skulls. It had to be done under a microscope and the hard

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rock particles picked off one by one with tiny needle-pointed instruments. After an hour of such tense nervous work, a man wants to scream and throw things. By the beginning of the New Year, Thompson had finished the preparation.

Regarding these archaic mammals, Professor Osborn has said, "There is little doubt that the extinction of the large terrestrial and aquatic reptiles which survived to the very close of the Cretaceous prepared the way for the evolution of the mammals. Nature began afresh with the small unspecialized members of the warm blooded quadrupedal class to slowly build up out of the mammal stock the great animals which were again to dominate land and sea. One of the most dramatic moments in the life history of the world is the destruction of the reptilian dynasties which occurred with apparent suddenness at the close of the Cretaceous, the very last chapter in the Age of Reptiles.

"We have no conception as to what world wide *cause* occurred, whether there was a sudden or a gradual change of conditions at the close of the Cretaceous; we can only observe that the world wide *effect* was the same: the giant reptiles both of sea and land disappeared." The mammals we have found were tiny creatures not larger than a rat and crawled about in the middle of the Cretaceous period, ten million years ago; they are to be regarded as the first attempts of nature to establish the insectivorous, carnivorous and herbivorous group of mammals.

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They may be said to represent the earliest ancestors of man, since they are among the most ancient members of the class Mammalia to which man belongs.

The skulls are especially important since they are among the earliest placental mammals which are related to existing groups.

At the time I am writing this chapter the study of the specimens has just begun. They are so exceedingly primitive that their relationship probably will be obscure. Superficially, they appear to represent at least two groups, one of which will almost surely prove to be the Insectivores. The living shrew and moles are true Insectivores, and it has long been known that they possessed a very ancient lineage. The other is the Creodonts, the very earliest carnivores or flesh eaters.

The discovery of these Mesozoic mammals means that we are digging at the very deepest roots of the mammalian family tree. It is too early even to predict what new information they will give us as to the facts of evolution but it is certain to be of profound importance. Although they appear to be so insignificant it is probable that after the dinosaur eggs have been forgotten these little skulls will be remembered by scientists as the crowning single discovery of our research in Asia.

On the way to the Flaming Cliffs, we had dropped Young, Butler, Robinson, Loucks, Chaney and Roberts at Artsa Bogdo, one of the mountains of the

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Eastern Altai. Chaney was to botanize and the others to hunt ibex and sheep. Nelson and Morris in another car were to make their way back to the main camp slowly studying several Old Stone Age human culture sites which had been discovered in our western trip.

While Olsen and Shackelford remained at the Flaming Cliffs hunting fossils, Granger and Berkey, Lovell and I left for a week's exploration of the little known country beyond the Altai Mts. The Russian map showed a great basin directly south of us across the frontier of Inner Mongolia. The map is so inaccurate that quite possibly no such basin exists but it was worth exploring. If it was a low lying area of sediments it was highly probable that it would contain fossils. No trails were shown and the Mongols said there were none so we prepared for a gruelling trip. Thirty miles from the camp the Gurbun Saikhan mountain (the "Three Good Ones") rises to a ragged horizon of low peaks. We could see a deep cut which looked like a pass and ran up to it on a beautiful slope covered with short grass and wild onions all in flower. The rocky gateway proved to be the entrance to a dry river bed which led us in and out among rounded hills and over lovely upland meadows to a spring of cold sweet water just over the summit of the pass. Right beside it were fine exposures of red sediments but not a fossil bone could we find in an hour's search. Sometime earlier the geologists had discovered a fragment of dinosaur bone

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in similar sediments to the east so that they felt sure that it was strata of the Age of Reptiles. They had determined that the Altai Mountains were a late uplift which had been pushed through the old sediments in late Tertiary times. From the southern exit of the pass we looked into a vast basin with exposures of red sediments on all three sides. But a day and a half prospecting and more than a hundred miles of travelling showed us that it was barren of fossils. Still it was interesting and we had a most illuminating example of how the country is cut and eroded by sudden storms. For an hour the Gurbun Saikhan ten miles away had been obscured by sheets of falling rain. Suddenly we heard a muffled roar and saw a flood of brown water advancing upon us down the slope. It came so fast that I had to run to keep abreast of it. The chocolate colored flood stripped off a thin layer from the surface of the plain, leaving in its wake new ridges and furrows. Thus goes erosion where there is no vegetation to hold the rain.

The Mongols were correct in saying that no caravan trails led southward, but we made three attempts to cross the desert where the distant mountain ridges lowered to the plain. Twice sand turned us back. The third trial was successful and for more than a hundred miles we ploughed southward over heavy terrain. Difficult passes let us through low mountain ranges and in one we had a narrow escape. Running rapidly up the smooth slope of a low hill

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and over the crest, a gorge thirty feet deep suddenly opened in front of us. Lovell threw on both brakes stopping the car six inches from the edge. I nearly had heart failure as I looked down into the ravine through the wind-shield. We were out of that car in about a second and a half. Then the question was how to get it back from the edge. If the machine slipped over we could walk to camp some two hundred miles away or stay there and die of thirst. The brakes were holding but a good strong puff of wind was all it needed to end our little joy ride. Eventually we worked it back inch by inch after blocking the rear wheels with stones so that it could not move forward. That was one of the narrowest escapes of our whole summer in Mongolia. Had the car crashed into the ravine the Expedition would have been shy five of its members.

The country we were crossing was hopeless from our standpoint. Narrow, ragged mountain chains, paralleled each other east and west; between them were sedimentary plains uncut by ravines or gullies so that there were no exposures in which to look for fossils. We pushed steadily southward to the edge of a vast area of ragged lava hills swept with yellow sand. From the summit of the highest peak we could look forty miles across this sea of desolation to the blue ramparts of a mountain chain which rimmed the basin we had hoped to reach. Nothing on wheels could cross that sand drenched chaos; a camel might get through but a horse would have been

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ruined in an hour; to circle it was out of the question without more gasoline than we had to spare. It was so obviously impossible that it tempered our defeat. Had there been a chance of getting through we would have turned back more sadly.

When ploughing up to another pass ten miles to the west we discovered a solitary *yurt* tucked behind a mass of rocks. Half a dozen Mongols ran out frantically signalling us to stop. It was a *yamen* (official post) on the frontier of Outer Mongolia. A more useless place for a *yamen* could hardly be imagined, for we had not seen a sign of habitation in many miles.

When we were returning through a mountain pass just before dark two great brown animals leaped into view on the saw tooth rim of the highest peak. Lovell saw them first. "Sheep as I'm alive," he shouted. There they stood, two magnificent rams, silhouetted against the sunset sky. Granger's rifle was in the car beside me. As Lovell switched off the power, I shot from the front seat sending a savage bullet into the quarters of the largest ram.

I wonder if any other man in the world has even seen a mountain sheep from a motor car, to say nothing of shooting one. It gave me quite a "kick" I must admit. I have killed a good many big horn sheep but never one that did not exact strenuous work. Hard climbing, skilful stalking, straight shooting is what sheep hunting means. To sit comfortably in a Dodge touring car and pot a Mon-

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golian *argalai*, the trophy *par excellence* of a sportsman's life, was a bit too much. Incidentally it relates the story of where we had taken that car about as plainly as it could be told. I am not surprised that the sheep were too curious to run away when the roaring black thing appeared among their mountain peaks. It seemed so strange even to us that at times we could hardly believe that we were really there.

The discovery next day of a caravan trail, paralleling the Altai Mountains sent us eastward for more than a hundred miles into the most awful desert I have ever seen. It was a bare gravel floor without even the stunted "camel sage" and wild onions which are able to exist where there is almost no rain. Carcasses of animals marked the track, telling an eloquent story of what a toll of life the desert had exacted from the last caravan that passed this way. A short distance from the trail lay the body of a man. What had been his story? We wondered if he had lost in the battle with thirst and hunger or if disease had taken his life alone in the silent spaces of the desert?

The eastern exploration was as unproductive as that to the south had been. Low ridges of Mesozoic igneous rocks and inter-mountain basins of undissected sediments formed an uninteresting assemblage to a fossil hunter. Since there was no indication that it would change for a long distance we returned to camp at the Flaming Cliffs. The exploration had taken us six hundred miles and although we were



One of the daily dozen. Pulling the big trucks through the sand of the Gobi Desert.



Above: skull of wolf. Below: skull of *Andrewsarchus* from the Eocene beds of Irдин
Manha, 1923.

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bitterly disappointed in not discovering new fossil beds, the negative information was valuable. A vast area had been eliminated from our future calculations and it determined definitely that we had already investigated the most interesting regions of Outer Mongolia. Although the fossil fields are so enormously rich and would not be exhausted by many years of work still that type of intensive study is not within the province of the expedition. Discovery and reconnaissance is our job and we feel satisfied that Outer Mongolia has very little more to offer us. We are all particularly glad that it is so for under existing political conditions none but Russians can work successfully in the country.

Interesting things had occurred in camp during our absence. When Young and I visited Urga in late May we had met a charming young Dane by the name of Birck, who was in the employment of a great English firm, the International Export Company. Birck had suddenly arrived in camp with a caravan of camels. His company had sent him to turn back a herd of ten thousand sheep which were on their way to Kwei-hua-cheng in North China. The sheep were to be diverted to Manchuria, just why Birck was not sure. He believed that war in China was the only possible reason and indeed it had seemed certain that Chang Tso-lin and Feng-Yu-hsiang would fight when we left in the spring. If it was war, the sheep would have been a heaven sent food supply for either one of the contending armies.

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George Olsen, the champion dinosaur egg hunter of the world, is also a Dane. It developed that he and Birck had come from the same little town in Denmark; he knew Birck's father and they had lived only a short distance from each other. Of course we all remarked how very small the world is, after all!

The war news was very disturbing. If Chang and Feng were really at it in earnest, the conflict would probably be near Kalgan or along the Mongolian border. In that event when we returned either army would welcome our motor cars with open arms. I did not intend to have that happen and as it was only July 25th, there was ample time for the war to be over before we reached China on September 15th. In the meantime it was possible that we might get more information.

Birck remained at camp only one day for he had to rejoin his caravan which was plodding eastward toward a *yamen* sixty-five miles away. There he was to await the arrival of his sheep.

Shortly after our return, Nelson and Morris who had been examining sites for primitive human cultures came in. Morris was ill with a strange malady that had affected almost all of us at some time during the last month. It was more like "flu" than anything else. Starting with violent chills the usual fever developed and then severe aching all over the body. Dr. Loucks dosed his patients with aspirin, kept them in bed and gave only soft food. Mac Young had the most severe attack and it was

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two weeks before he was fit. It is the first time that there has been any sickness of importance on our various expeditions. The Mongolian climate is so healthy and we lead such a normal outdoor life that a surgeon is likely to be merely an insurance policy. Gunshot wounds and broken bones are always imminent but thus far we have escaped scot free. Two days after Nelson and Morris arrived the shooting party whom we had left behind at Artsa Bogdo came in with eight fine ibex and two big-horn sheep. They had had a glorious week and obtained material for a group in the Field Museum of Natural History at Chicago which I had promised to President Field.

It was delightful to have the entire staff together again and to hear of the experiences and discoveries of each party for except when we are travelling it is seldom that everyone is in camp at the same time.

Since our exploration south of the Altai Mountains had not produced positive results in the way of new fossil fields the only alternative was to return to the "Well of the Mountain Water" in Inner Mongolia where we knew there were extensive unexplored beds. I had left this region as a reserve in case the country of the far western Gobi did not prove as interesting as we expected. On August 2nd we departed from the dinosaur egg beds, the "Place of the Muddy Waters" with regret. This single spot had given us more than we had dared to hope from the entire Gobi Desert. When the expedition took the field in

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1922 Mongolia was almost an unknown country from the standpoint of natural science. We had been told that Mongolia was barren palæontologically and geologically as well as physically. Yet the first dinosaur eggs known to man, a hundred skulls and skeletons of unknown dinosaurs, seven Mesozoic mammal skulls and the primitive human culture of the Dune Dwellers, all had come from a few square miles in this lovely basin! Is it surprising that I was filled with regret as I looked for the last time at the Flaming Cliffs gorgeous in the morning sunshine of a brilliant August day? I knew that I would never see them again. "Never" is a long time but the active years of an explorer's life are short and new fields are calling for those that remain to me. Perhaps some day I might view the Cliffs from the window of a trans-Gobi train but my caravan never again will fight its way across the long miles of desert to this treasure house of Mongolian history. Doubtless it will be the hunting ground of other expeditions for years to come. We have but scratched the surface and every season of blasting gales will expose more riches hidden in its rocks. Who can tell what will come from a place that has given so much already?

CHAPTER XIX

SNAKES AND FOSSILS

THE Flaming Cliffs, the tomb of dinosaurs and eggs, had been left behind us for the Central Asiatic Expedition was homeward bound. We had been playing with scattered herds of antelope along the trail waiting to pick up two or three yearling bucks for meat and my car was a mile in advance of the fleet.

An exciting run had just ended and two fat gazelles were slung on the fenders of the car, when Dr. Loucks shouted to stop. Half a mile to the north lay a low, ragged mass of rocks, the root of an ancient mountain peak. On the very summit, silhouetted against the sky stood two magnificent big-horn sheep quietly gazing at us. The glasses showed that they carried superb horns; great circlets at least sixty inches in length.

It was Mac Young's turn to get a sheep so we waited for his car to arrive. Meantime the animals remained motionless as though carved from granite. Not until we were less than a quarter of a mile away

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did they slip over the crest and disappear. We could not find those particular sheep again, but they gave us an idea. Jichi Ola, an elongate, rugged mass of granite rose abruptly out of the plain fifteen miles away. It ought to have sheep also and perhaps we could get them from the car. I had shot a fine ram while crossing the Altai mountains and it was a decided novelty to hunt one of the wildest and most difficult of big game animals from the cushioned seat of an automobile!

The tents were pitched close up against the base of Jichi Ola near a well of fine cold water. On all sides rolled the arid reaches of the desert like the swelling surface of a vast brown sea. A hundred yards behind the cook tent Shackelford flushed a *woodcock*. A bird of paradise would have been no more out of place than this shy inhabitant of wooded swamps out there in the centre of the Gobi! But we realized that the woodcock was migrating southward and had lost its way. Wisely it had chosen to lie concealed among the rocks until night came and it could resume its journey safely.

Four or five of us hunted the next day and nearly all the men got sheep, but they were all in the highest peaks. Dr. Loucks returned late in the afternoon to report that he had killed a wolf and two sheep far down toward the end of the mountain; he thought we could get fairly close with an auto.

Robinson, Loucks and I in the touring car skirted the base of the ridge and almost immediately saw

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two sheep standing on one of the higher peaks. They ran toward us as we advanced, apparently fascinated. Keeping the engine running we stopped. "Robbie" slipped behind a rock, and at four hundred yards knocked over a young ram.

Evidently the time had come to hunt from the car, for as the shadows lengthened the sheep worked out from the peaks to the lower slopes to feed. By careful manipulation we worked the car through rocky gateways far up into valleys which cut deep into the mountain. The roar of the engine echoed like a machine gun among the cliffs, but it seemed to attract, rather than frighten, the animals. We saw fifteen, I believe, and shot three—not such a bad record for big-horn sheep, especially when we sat comfortably in a motor car all the while!

I think none of us will ever forget the drive back to camp through a narrow defile. Exactly in the centre of the gateway hung a crescent moon partially eclipsed which threw a wan, unreal light among the rocks. In the path of our head lamps, kangaroo rats leaped and danced like elfin sprites, and once the dim shadow of a wolf crossed into the darkness of the plain.

The next day while Granger was visiting a red outcrop which stood isolated on the desert four miles from the mountain, he came upon a band of female sheep led by a young ram. Following them in his car for a mile or so, he found that the highest speed they could reach was twenty-five miles an hour.

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They tired quickly, however, and finally gathered into a compact group. Running up to within a hundred yards of them he stopped. The sheep looked at him as much as to say, "It is your next move."

While he was trying to get his camera they decided to leave and the group suddenly separated, each one dashing wildly for the nearest point of rocks.

The *yamen* (official post) where our caravan had been detained in the spring was the point where we would again cross the frontier into Inner Mongolia from the Soviet-controlled region in which the expedition had been working all summer. We were curious to know what would happen. I carried enough documents from the Urga government to paper a good size room but in the spring they had been ignored by the petty officials. All summer we had had with us an officer of the Secret Service whose duty it was to see that there was no more difficulty at the *yamens* and to vouch for the expedition. Of course he was there principally to report upon our activities but as we had nothing to conceal and he was a very decent fellow, he did not annoy us.

The night before we arrived at the *yamen*, Berkey discovered a great deposit of iron ore not far from the well where we were camped. It was rather low grade containing a good deal of chromium but if a railroad ever is put through the desert it should be of considerable value. According to my agreement

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with the Mongol authorities we made a careful report so that they will be able to investigate it in the future.

All the officials at the *yamen* had been changed since our last visit. They were pleasant enough and allowed us to go without difficulty. But later, after the Secret Service officer had left and Lovell and Roberts returned to the caravan with two cars to obtain additional supplies of gasoline, they found the usual unbearable insolence. Guns were drawn on both sides, but when the *yamen* officials saw that our men were not to be browbeaten they gave in and no blood was spilled.

Although the *yamen* told the Secret Service officer that they would allow our caravan to proceed when it arrived a few weeks later, we took no chances but drove a hundred miles with six heavily armed men to see that their promises were kept. We were rather a grim-looking party when our car roared up to the *yamen* and the officials could see easily enough that we did not intend to argue with them concerning the right for our camels to pass. It was a great relief when all the expedition was safely across the border in territory which is under the jurisdiction of the Chinese.

At the *yamen* we were told that there was no war in China but that there had been trouble in Peking and surrounding areas. The information was so indefinite that I was considerably worried. I had no wish to bring our specially equipped cars into a situation

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where they might be confiscated by some general who had need of transport.

We were in camp at the "Well of the Mountain Water" barely three hundred miles from Kalgar. Granger and Berkey had made a short reconnaissance trip to the northeast and reported new and very rich fossil deposits. The work of the topographers and botanist was virtually finished and Shackelford could use the time to great advantage in Peking developing films. Therefore I decided to run in with two cars, take Butler, Robinson, Chaney and Shackelford back to Kalgan and after a look at the political situation return with Mac Young to the expedition for another month in the field.

A few days before we started Shackelford had an opportunity to photograph the greatest herd of antelope that I have ever seen. We discovered them one morning six miles from camp streaming up out of a great basin. Thousands upon thousands of bucks, does and fawns poured in a yellow flood over the rim and spread out like a vast fan upon the plain. Shackelford had his motion picture camera strapped in the back of the car and we worked with the herd for hours. But it was rather unsatisfactory because as long as they remained on the flat plain we got them in the picture only as a long line of moving animals.

It was certain that they would not travel far for the feed was excellent where they were. Therefore, in the morning we went out again as soon as the

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light was strong. This time they had arranged themselves as though directed by a stage manager. Perhaps fifty thousand were in the bottom of an enormous valley where from the edge we could "shoot" down at them with the telephoto lense. There was a light wind and for the first time in my life I could *smell* the antelope. A mile away the squalling of the babies reached us. With the glasses we could see them nursing and playing; all the intimate details of domestic antelope life were carried on before our eyes. Sometimes a thousand or so would dash at full speed through the centre of the herd, only to stop abruptly and begin to feed. The mass was in constant motion; hardly for a moment was any part of it stationary although the animals were entirely at peace.

I was surprised not to see a single wolf. Such a vast gathering should have attracted all the wolves for miles around, but as a matter of fact, wolves are remarkably scarce in Mongolia. One finds them most frequently near the caravan trails where dying camels give them food but then they are only singly or in pairs.

After we had watched our antelope for nearly an hour and exposed a thousand feet of film, we dashed down the long slope directly into the herd. We were almost on them before they decided that it was time to really run. Then it was most amusing to see them leap over each other to avoid the car. With ears laid back the babies put every ounce of strength into

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the race and for a mile or two they could do fully as well as their parents.

The herd divided into a hundred units and we chased one after another until the plain was alive with antelope running wildly about in search of their husbands, wives or children. But within a few hours they had again collected into a compact mass and in the afternoon we saw them from afar like a splash of yellow paint on a vast green canvas.

It is only the grass land antelope (*Gazella gutturosa*) that gathers into such vast herds. In the spring just before the young are born the females collect on a flat plain and separate as they drop their babies. In the fall the bucks, does and fawns again assemble.

The long-tail desert species (*Gazella sub-gutturosa*) never herd. I imagine the reason is because there is no spot on the desert that could give sufficient feed for more than a hundred.

We started for Kalgan just after a heavy rain and in the afternoon had an experience which might easily have cost us a car. A dry river bed barred our way. Butler and Chaney prospected it and waved me to come on. Fortunately, there was a steep bank on the opposite side and I started across at forty miles an hour. Suddenly, "plop!" I had a sickening sense of everything going out from under me as the car dropped into a quicksand well. It was the same type of death trap into which the *Baluchitherium*, whose legs we found had sunk three

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million years ago. It had been fossilized standing erect. Had we not had another motor with us, a million years from now someone might have excavated a fossilized Dodge touring car in just the same way!

The quicksand was narrow and the speed of the car had carried its front wheels across the well. The rear end was sunk at a dangerous angle but with the "pull out" cables on the other motor we drew it to firm ground.

There had been an unusual amount of rain during the summer and the grass lands were blazing with flowers. Chaney reaped a harvest of new species for we had arrived at just the right moment; a week later half the flowers had withered.

As we neared Kalgan we began to get bits of information regarding the political situation in China. There was no war but a great strike of students and a boycott on British firms had been going on all summer. That was the reason why a herd of ten thousand sheep *en route* to Kwei-hua-cheng had been diverted to Manchuria; it was from their men that we had had our first intimation of trouble in North China. The news was very comforting for evidently it was quite safe to proceed to Kalgan.

Peking was seething with excitement; therefore it was enjoying itself hugely. It seemed very strange to come into the flower filled courtyards of my house and don formal evening dress for a dinner within a few hours after leaving the desert. But I

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had given myself only three days in which to enjoy the luxuries of civilization.

As soon as a few necessities had been gathered together we started back to Kalgan.

The Danish Minister, Mr. H. Kaufmann, and Mr. and Mrs. Mason Sears of the American Legation were contemplating a trip to Urga so I invited them to visit our camp *en route*. Mr. Robert Williams took them in his car and we had rather a messy time of it on the return journey. Floods of rain had converted the grass lands into bogs, but on the fourth day we saw the blue tents dancing in mirage on the rim of the great basin twenty miles from the "Well of the Mountain Water."

It was a beautiful camp and very productive. As soon as we had eaten tiffin, Walter Granger took us to inspect the "diggings." George Olsen had several skulls exposed and Granger and Berkey had come to the conclusion that they were dealing with a new geological horizon. It probably represented the Upper Eocene, or Dawn Period of mammalian life. The most interesting specimen was the skull of an extraordinary beast that Dr. Loucks had discovered. It had lived in this region three or four million years ago and must have been a veritable nightmare creature. Two thick bony horn-cores about eighteen inches long by six inches in circumference projected up and forward from just above the eyes. The horns swelled at the ends like clubs and probably were covered with skin as are those of the giraffe.

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None of us have the remotest idea what the beast was or to what group it belongs, except that it probably was a hoofed animal. It is very seldom now that one can find a mammal which cannot be readily classified; but Loucks' discovery is utterly unlike any previously known creature as far as our knowledge goes. The specimen was in very bad condition and no one with less experience and patience than Walter Granger would have been able to remove it at all. The bone literally was in powder and could be blown away. Granger soaked it first with gum arabic which cemented the minute particle together; then he stippled on Japanese rice paper, and when this had dried he was able to expose a little more of the bone and repeat the operation. Eventually it was bandaged with strips of burlap soaked in flour paste which formed a hard shell.

The morning after our return to camp, Granger came in to report that Chih, one of the Chinese collectors, had discovered an enormous skull. We all went down to watch the excavation, for that is the most exciting part of fossil collecting. Just the tip of a great bone was exposed and as Granger worked away the surrounding matrix it proved to be the occipital part of the skull. It was so large that at first we supposed it to be another *Baluchitherium*, but as the excavation proceeded it became evident that what we had was a *Titanotherium*. These huge beasts which superficially resembled a rhinoceros, were only known from America until we discovered

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them in Mongolia. Our first and second years of work had produced very early, primitive types but this was a much later and larger form, representing the very summit of their evolution. In America the corresponding species had an enormous forked horn on the nose. In this specimen the nasal region was gone, but the teeth and other parts of the skull told the story almost as completely as though every bone was present.

Meanwhile Nelson, our archæologist, had found a rich field in the same exposures which produced the fossils. On a gravel slope facing west were twenty or thirty piles of rock which indicated human work. They were in orderly arrangement and he was convinced that they must represent burials.

It required considerable effort to remove the rocks for some of them were huge slabs sunk several feet into the earth. Two graves were empty, but one produced interesting results. First, he encountered heavy timbers beautifully preserved; under these lay the perfect skeleton of a man. He must have been five feet ten or eleven inches tall and beside him lay a birch bark quiver filled with arrows. Some of the shafts were of wood; others were partly of reed tipped with wood. The points were iron but strangely enough the metal was badly corroded and in poor condition. The bow had separated into half a dozen pieces but they can be fitted together at the Museum.

To me the most interesting thing in the grave was a

saddle upon which the man's head was resting. He must have worn a turban for bits of the cloth still adhered to the skull. The saddle was well preserved and when Nelson brought it to camp it proved to be a perfect McClellan type such as our army uses today. We had several with us and the similarity was amazing. General McClellan without doubt thought that he had developed a new saddle just as we supposed that we were the original discoverers of the dinosaur eggs. But in both cases primitive dwellers of Mongolia had made the discoveries centuries before we were born.

The saddle is quite unlike that used by Mongols or Chinese today or in the past, so far as I am aware.

Nelson thought that the grave must be at least a thousand years old and probably much more than that. The fact that it was placed in a well drained slope and the extreme dryness of the desert undoubtedly accounts for the splendid preservation of the wood and bones. It was impossible to identify the skeleton in the field, but its racial characters can be determined by study at the Museum.

Berkey and Morris found evidences of other pre-historic people in rather an interesting way. They were sitting in a Mongol's *yurt* twenty miles from the "Well of the Mountain Water" when Berkey's attention was caught by a small nugget of copper ore lying on the family altar. The Mongol was definite in his information that it came from a spot quite near a temple fifteen or twenty miles to the south. The

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geologists visited the place and found evidences of surface mining operations on a large scale. A vast pit had been excavated in the hillside; so large, indeed, that at first they did not believe it could be artificial. The copper was not in veins and the deposit had been so thoroughly worked that but comparatively little remained. They studied the place carefully and came to the conclusion that the mining operations must have ceased at least a thousand years ago.

While we were at the camp where Nelson had found his grave, the antelope herd which Shackelford had discovered paid us a visit. We heard them pouring down into the basin during the night and two days later the whole mass came up again not more than four hundred yards from camp. While we were at breakfast the bleating of the fawns and the "tap tap" of thousands of tiny hoofs brought us all out of the tent. A vast yellow blanket of moving forms was flowing over the rim of the bluff on to the plain. Wolf, my police dog, went wild with excitement. He chased first one group and then another until he was exhausted, but the antelope could leave him behind so easily that they only bothered to run when he was almost upon them.

When we were ready to move to another fossil locality ten miles to the north we asked the priests of a nearby temple for permission to deposit our specimens in their care until the caravan arrived. We had done this half a dozen times during the

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preceding two years. They said that we could leave gasoline or rocks, but no fossils, because last summer many horses and sheep had died in the vicinity and that doubtless it was due to the bad influence of the "dragon bones."

Our next camp was very similar to the one we had left. The tents were pitched on a great promontory which projected far out into the basin. Near them was an *obo*, or religious monument, and shortly after our arrival two lama priests came to call. They were delegates from a temple four miles away, they said, and asked us to be particularly careful not to shoot or kill any birds or animals on the bluff. It was a very sacred spot and the spirits would be angry if we took life in the vicinity. Of course I agreed to respect their wishes and gave orders at once. But we had promised more than we could fulfill, as events proved.

Within the first two hours of prospecting three pit-vipers were discovered close to the tents. It is almost the only snake in the desert but is an extremely poisonous species. A few days later the temperature suddenly dropped in the late afternoon and the camp had a lively night. The tents were invaded by an army of vipers which sought warmth and shelter.

Lovell was lying in bed when he saw a wriggling form cross the triangular patch of moonlight in his tent door. He was about to get up to kill the snake when he decided to have a look about before he put

his bare feet upon the ground. Reaching for his electric flash lamp he leaned out of bed and discovered a viper coiled about each of the legs of his camp cot. A collector's pickax was within reach and with it Lovell disposed of the two snakes which had hoped to share his bed. Then he began a still-hunt for the viper that had first crossed the patch of moonlight in the door and which he knew was somewhere in the tent. He was hardly out of bed when an enormous serpent crawled out from under a gasoline box near the head of his cot.

Lovell was having rather a lively evening of it but he was not alone. Morris killed five vipers in his tent and Wang, one of the Chinese chauffeurs, found a huge snake coiled up in his shoe. Having killed it, he picked up his soft cap which was lying on the ground and a viper fell out of that. Dr. Loucks actually put his hand on one which was lying on a pile of shotgun cases. We named the place "Viper Camp" because forty-seven snakes were killed in the tents. Fortunately, the cold had made them sluggish and they did not strike quickly. Wolf, the police dog was the only one of our party to be bitten. He was struck in the leg by a very small snake and as George Olsen treated the wound at once he did not die. The poor animal was very ill, and suffered great pain, but recovered in thirty-six hours.

The snake business got on our nerves a bit and everyone became pretty jumpy. The Chinese and Mongols deserted their tents, sleeping in the cars and

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on camel boxes. The rest of us never moved after dark without a flashlight in one hand and a pickax in the other. When I walked out of the tent one evening I stepped upon something soft and round. My yell brought the whole camp out only to find that the snake was a coil of rope. A few moments later Walter Granger ventured outside lighting his way with a flash lamp. In the tent door he made a vicious lunge with his pick shouting, "I got you that time!" But Walter had merely sliced a pipe cleaner which I had just thrown out!

We had to break our promise to the lamas and kill the vipers but our Mongols remained firm. It was amusing to see one of them shooing a snake out of his tent with a piece of cloth to a place where the Chinese could kill it. The vipers were about the size of our "copperheads," or perhaps a little larger. While their fangs probably do not have enough poison to kill a healthy man, it would make him very ill.

The snakes inhabit bluffs like the one on which we were camped, throughout the desert, but their great numbers at this particular spot was due to the fact that it was a sacred place and the Mongols would not kill them there.

This viper appears to be the only poisonous snake in the Gobi and, as a matter of fact, we collected but one non-poisonous species. The climate is too dry and cold to favor reptilian life.

The new camp proved to be just as rich in fossils as it was in snakes. One place which evidently had been

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the bed of a stream that had flowed there four million years ago was a veritable quarry of fossil bones. Twenty-seven jaws were exposed at one time in the same layer and it was only necessary to scrape off a few inches of sediment in almost any spot to uncover valuable specimens. We got skulls of a peculiar beast known as the *Chalicotheres*, a veritable paradox. It is a "clawed hooped animal." The head and neck are like those of a horse, the teeth like a rhinoceros, and the feet like nothing else on earth. Instead of hoofs the creature was armed with claws. Why such an anomaly was developed no one can tell. There must have been some good reason for nature does not produce such extraordinary appendages haphazard, but thus far explanation is obscure.

The region swarmed with a little hooped beast known as *Lophiodon* and the palæontologists obtained a great collection of jaws and skulls which represent many unknown species and genera. Thus far we have found no trace of horses in the very old formations. This is a great surprise for the unknown five-toed ancestor of the horses is one of the types which we confidently expected to discover. Four-toed horses are present in the Eocene of both America and Europe and we are certain that the ancestral stock developed in Asia, but as yet it has eluded us. Nevertheless it must be there and we hope to discover it eventually.

While work was proceeding at Viper Camp, six of us made a five hundred mile exploration south and

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west into a region which we hope to investigate during the summer of 1926.

The trail of primitive man appears to indicate the south and in the coming year we will follow wherever it may lead. What the results will be no one can predict for it is a new and unknown country.

Rain and light snow warned us to be on our way to Kalgan when we returned from the southern exploration. The sand grouse were flocking and golden plover had arrived from the Siberian tundras in thousands. They are signs which the experienced Mongolian explorer does not ignore.

On September 12th we roared down the slope to the basin floor leaving Viper Camp to the snakes and vultures. Another season had ended and we were well content.

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